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ROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

HANDBOOK ON MULCHES

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Mulches
or Various
rnamentals

SPRING
1957

EW SERIES
13 No. 1

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PLANTS & GARDENS

Vol. 13 Spring, 1957 No. 1

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Editorial

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Except where noted, all drawings by P. K. Nelson

Published quarterly at 3110 Elm Avenue, Baltimore, Md., by the **Brooklyn Botanic Garden, Brooklyn 25, N. Y.** Entered as second-class matter at the post-office at Baltimore, Md., under act of August 24, 1912. Subscription included in Botanic Garden membership dues. To others: $2.00 per year; $3.75 for two years. Copyright, 1957, by the Brooklyn Botanic Garden.

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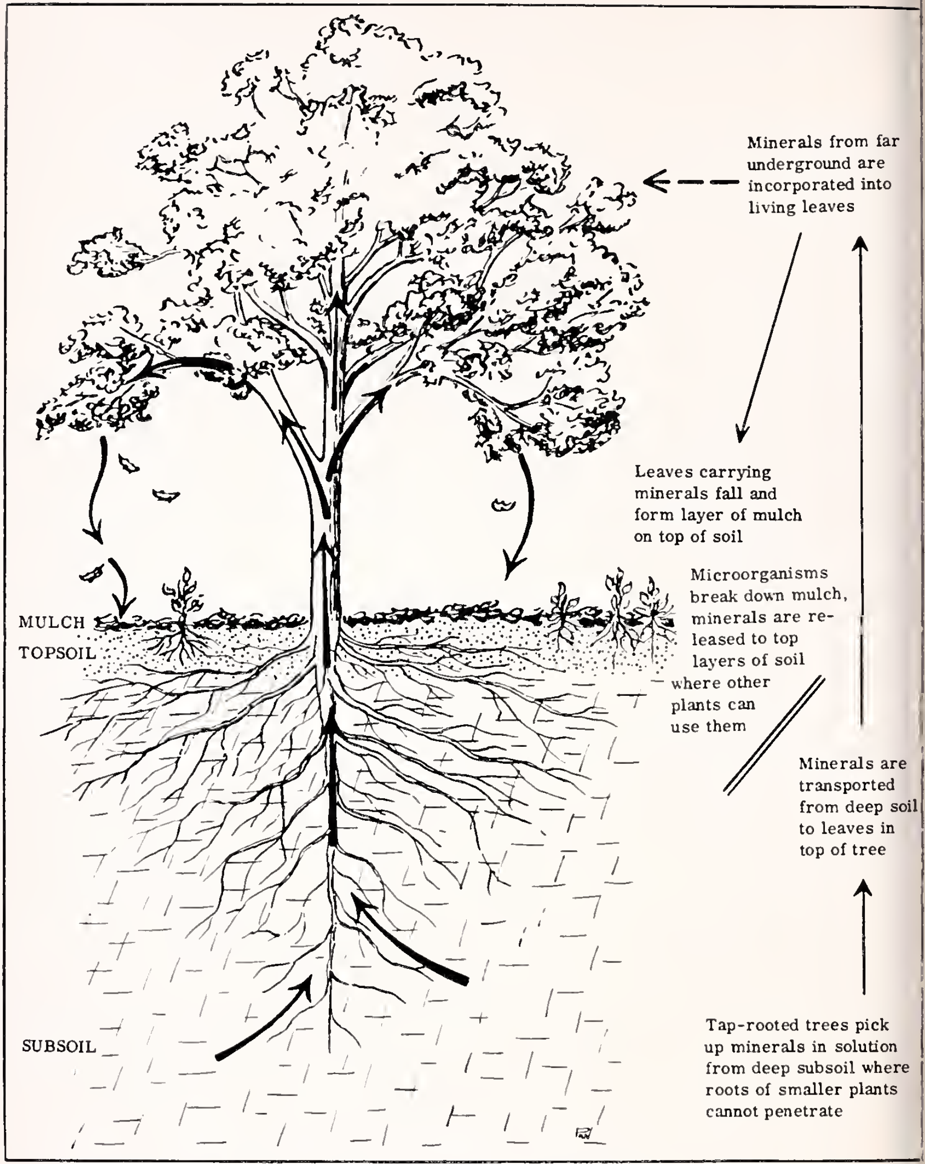

Minerals from far underground are incorporated into living leaves
Leaves carrying minerals fall and form layer of mulch on top of soil
Microorganisms break down mulch, minerals are released to top layers of soil where other plants can use them
Minerals are transported from deep soil to leaves in top of tree
Tap-rooted trees pick up minerals in solution from deep subsoil where roots of smaller plants cannot penetrate
MULCH
TOPSOIL
SUBSOIL

Wherever deep-rooted plants are growing they ''mine'' the subsoil for elements essential t their life and growth. Dead leaves and other debris carrying these minerals fall to th ground where they make a natural mulch. This mulch, when it decays, releases the mineral to the topsoil; it also adds organic material, thus keeping the topsoil in good physical condition. The mulch helps prevent run-off of rain water, and reduces evaporation of moistur from the soil. All these beneficial results man likewise accomplishes when he carries ou wise mulching practices.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
BROOKLYN BOTANIC GARDEN
1000 WASHINGTON AVENUE
BROOKLYN 25, NEW YORK
TELEPHONE: MAIN 2-4433

Spring 1957

In its simplest terms, mulching is man's version of what happens on the floor of a forest where over the decades tree litter accumulates and gradually decays. The soft forest cushion that every lover of nature likes to walk upon, is a natural mulch. It is in this accumulation of dead leaves, twigs, fallen branches, fallen trees, etc., that bacteria, fungi and other simple living organisms carry on the process of decay. It is here, in nature's scheme, that the raw materials borrowed from the earth and so dramatically "spun" into the architecture of living things, are equally dramatically released, i.e., unlocked from one another, and returned to the earth in simple form—to be borrowed again and again by generations of living things. The elements once on loan to a hemlock for its lifetime, might a century or two later be on loan to an oak, a maple, or a pink lady-slipper.

In adapting this natural mulch phenomenon to his cropping practices and to the growing of ornamental plants, man uses whatever dead organic matter may be available. The principle is the same. The labor saved and other manifold advantages of the practice are the subject of this Handbook.

Guest Editor Frese, the authors he has invited to contribute, and our Editorial Committee, have all concentrated on bringing the finest possible how-to-do-it Handbook to our readers.

If people generally understood the desirability of mulching practices, we would never again need the phrase "Don't burn leaves." Perhaps the admonition should be "Be a mulcher." The words may not be pretty ones, but they carry an idea that should have the attention of every thoughtful person whose fingers are in the soil.

Yours sincerely,

George S. Avery, Jr.

Director

DIRECTORY OF MULCHES DESCRIBED IN THIS HANDBOOK

Material	*Where Available*	*Remarks*	*Page*
Aluminum Foil	garden supply, department and grocery stores	too conspicuous for ornamental plantings; can be recovered for use second year	12, 38
Asphalt	road-paving contractor, occasional lumberyards	a very light application holds soil in place on steep banks until grass cover becomes established	49
Asphalt Paper	hardware or building supply dealers	seldom used	20
Buckwheat Hulls	garden supply stores, order from packaging firm	fine texture, long life and good color make this a good mulch for ornamental plantings	12, 13-17, 18, 24, 32 34, 68
Cocoa-bean Hulls	chocolate or candy manufacturing companies; wherever cocoa beans are roasted	fine texture, good color; because it may pack, it is better mixed with sawdust 2 to 1	18, 30, 34
Corncobs (ground)	corn-growing areas, such as the midwestern states	good mulch but not especially attractive for ornamental plantings	12, 18, 49 60
Cornstalks	harvested gardens and cornfields	very coarse, useful for holding down other mulches; may harbor borers and other pests	24
Cranberry Clippings	where cranberry bogs abound, e.g., Cape Cod, parts of Wisconsin	attractive winter mulch especially for broad-leaved evergreens	26
Crushed Stone or Gravel	most building contractors or lumberyards	of limited use; good for alpine plants	13, 35
Hay	farms, feed stores or cut from own property	widely used; leguminous hays, such as alfalfa or clover, decay faster than grasses and supply considerable nitrogen	12, 13, 58 60
Hops (spent)	breweries	good, but odor, which persists for a few weeks, may be objectionable; very light color; fire resistance is a great advantage	12, 29
Lawn Clippings	home lawn	satisfactory if used with care; green clippings may heat excessively and mat	24, 77-79
Leafmold	made by composting leaves raked in fall; sometimes obtainable from woods	particularly well suited for wildflowers	77

Material	*Where Available*	*Remarks*	*Page*
Leaves	wherever deciduous trees grow	make better mulch if composted first; some such as maple and poplar tend to mat; oak leaves excellent for rhododendrons	12, 17, 19, 23, 35, 64, 73
Manure (strawy)	farms or stables	provides some nutrients; may burn plants if too fresh	13, 32
Mushroom Compost (spent)	commercial mushroom growers	dark color; slight nutrient value	32, 33
Paper Pulp	make at home from newspapers and sawdust	most practical for large planting, as special mixer is needed to prepare	46-47
Peanut Hulls	peanut-growing areas, chiefly in the southern states	good mulch, but not especially attractive for ornamental plantings	65-66
Peat moss	most garden supply stores	fine texture and good color, but has tendency to dry out and then become impervious to water	12, 18, 27 28, 33, 34, 68, 73
Pine Needles (and those of other conifers)	wherever conifers grow	attractive and useful for wildflower and other plantings	13, 23, 33, 62, 67
Plastic Film	most garden supply stores	practical for large areas, unattractive on ornamental plantings	43-45
Salt Hay	near seashore	excellent general mulch	24
Sawdust	near sawmills, lumberyards or other wood-working operations	good general mulch; certain kinds are said to have toxic effects, but these reports are not well authenticated; will often cause nitrogen deficiency, which can be corrected by fertilizing	8-9, 28, 34, 50-53, 54-55, 64-66
Seaweed (kelp, etc.)	near seashore	good; adds mineral elements to soil; not attractive for ornamental plantings	26
Straw	feed stores and farms	coarser, more durable than most kinds of hay	12, 23, 56-60
Tobacco Stems (chopped)	tobacco-growing areas	coarse; may discourage insect attack	18, 73
Wood Chips	locally available from utility maintenance operations; can be made from prunings if chipper is available	useful method of disposing of waste twigs and branches; good mulch, coarser than sawdust, less apt to cause nitrogen deficiency	28, 34, 40-42, 51, 66

HOW I MULCH MY GARDEN

George L. Slate

MULCHING has been a standard practice in my garden for several years. I much prefer it to cultivation. If I didn't mulch my garden, its size would have to be greatly reduced. I spread mulch during the late fall and early winter, when the snow is not too deep. At this season there is little other gardening work to do.

Labor Saving

The benefits of a mulch in the garden are several, but for me the saving of labor is most important. A thick mulch eliminates most of the weeds. Only a few of the strongest growing perennial ones are able to push through the mulch. Hoeing, therefore, is not necessary, though an occasional weed will have to be pulled by hand. The principal weeds not controlled by a mulch are bindweed, quack-grass and Canada thistle. In beds planted with bulbs, whose foliage dies down before fall, these weeds can now be eliminated with chemical weed-killers: bindweed with 2,4-D, quack-grass with Dalapon, and Canada thistle with amino-triazole.

Moisture Benefits

The second important benefit of a mulch is in the conservation of soil moisture. A good mulch will reduce the amount of water lost from the soil by direct evaporation by at least half. The moisture supply that is kept uniform under a good mulch favors root activity in the surface soil. On a slope, runoff of heavy rains is prevented. Also, rain soaks into a mulched soil more readily because the physical condition of the soil is much improved. The effects of irrigation las much longer on a mulched soil.

Effects on Soil

Soil temperatures are lower and mor uniform under a mulch than under clean-cultivated soil surface. This stabilizing effect favors bacterial activity. mulch also prevents deep penetration o frost in winter, a very important featur when severe cold occurs without coverin the ground with snow. A straw mulch i especially effective. I remember that during the winter of 1933-34, when record-breaking low temperatures occurred without a snow cover, tender rootstocks o fruit trees were injured.

Another benefit of a mulch is the improvement of soil structure and tilt As the decaying organic matter work down into the soil, it becomes more friabl is better penetrated by water, and it aeration is improved, thus stimulatin root and biological activity. Rapidly decaying materials such as legume hay an ground corncobs are more effective tha slowly decaying ones such as peat moss A mulch will prevent a heavy soil fro being compacted when walked on soo after a rain.

Mulching also eliminates root injur caused by deep cultivation and hoeing Damage from deep tillage is far mor frequent than is generally realized. Ther are few surface roots in a frequently tille soil. *But in a mulched one feeding root are encouraged to develop in the top soil, the best soil in the garden.*

Some mulching materials, especiall legume hays and grass, add substantia

Judkins

Sawdust is an excellent multi-purpose mulch. The moist, friable condition of the soil under the mulch on this bed of green peas can be seen where the sawdust is scraped aside.

amounts of plant nutrients to the soil. In fact, one experiment station worker says of mulching fruit trees, "In the absence of fertilizer applications a hay mulch provides nearly ideal conditions for tree development and performance." Mulched trees have substantially outyielded cultivated trees, even when the cultivated trees were fertilized, and those mulched were not. However it is possible for the mulch to have a deleterious effect if a legume or heavily fertilized mulch is applied, for it will stimulate excessive late growth that may be susceptible to winter injury. Also, heavy mulching of apples for several years may result in poorly colored fruits and excessive dropping.

Potash, which tends to be fixed near the surface of cultivated soils (because the surface is alternately wet and dry), penetrates much deeper in a mulched soil, which is more uniformly moist. Potash deficiencies are corrected most rapidly by supplying potash in conjunction with a mulch. Over a period of years hay and straw mulches will supply substantial amounts of potash as they rot.

Mulches have many other lesser benefits. They prevent drop fruits from bruising. Low-hanging raspberries, gooseberries and strawberries are protected from splashing soil during heavy rains. Daffodils and low-growing flowers are not mud-spattered when mulched. In the spring, when the ground is soft and muddy, a mulch makes it possible to walk close to the plants. This is especially important when the flower beds are not surrounded by grass.

During the winter when there is no snow cover a mulch is necessary to prevent newly-set plants from being heaved out of the soil by frost action. Straw-

McFarland

Mulching azaleas with oak leaves.

berries must be well mulched with marsh hay or straw to prevent freezing the crowns.

Disadvantages

Mulches have some disadvantages, too. Some materials are a fire hazard, so should not be used in large areas where careless smokers pass by. Straw and hay bring mice to the orchard, but setting out poison baits or mounding gravel around the base of the trees will provide protection. Frost may be more injurious to mulched plants, because a mulch prevents radiation of heat from the soil. The heat radiated from bare ground may prevent frost damage.

Materials

There are many mulching materials. Those listed below are my favorites; also, see the accompanying articles in this handbook. To be economically practical, a mulch should be available in quantity nearby and at a reasonable price. It should be attractive, durable, and fire resistant, if possible. If the material is to be used in working areas its appearance is not as important.

A Favorite Mulch

Sawdust is excellent for many plants. I use it regularly for all bulbs—lilies, daffodils, tulips, crocus, scillas and all the small plants. They push through it easily in the spring. Later, the flowers are protected from splattering mud during hard rains. At least once every spring the daffodils are beaten down by a heavy rain; but only a little sawdust splashes on them and it falls off as they dry. Without a mulch the daffodils would be ruined. I also mulch peonies and eremurus with sawdust, but many other plants could be

Gilman

Asparagus grows up through 6-inch mulch of maple leaves put on the previous fall. Mulches are especially valuable on asparagus because they control weeds, the ruin of many an asparagus bed.

Gilman

The presence of earthworms often indicates fine physical condition of the soil; here they are abundant under a straw mulch.

mulched with sawdust, too. A friend of mine mulches his gladiolus with sawdust.

Blueberries respond well to a sawdust mulch. In fact, where sawdust has been compared experimentally with other materials and with clean cultivation, the sawdust-mulched plants have been markedly superior to the others. So far as I know, other ericaceous plants such as azaleas and rhododendrons have not been mulched experimentally with sawdust; but there is no reason to doubt that sawdust would be as effective with them as with the blueberries (see page 54).

Sawdust is an unusually effective summer mulch for everbearing strawberries. When they are grown under clean cultivation in the matted row, yields are often disappointingly low. But when grown in hills and mulched with sawdust, excellent crops have been obtained.

Sawdust may rob the soil of nitrogen because the bacteria, whose activity is encouraged by the sawdust mulch, draw heavily on the soil nitrogen. And in all except very fertile soils there is often not enough nitrogen for both plants and bacteria. Additional nitrogen should be applied to prevent this deficiency (see page 52). A lack of good green color in the foliage will indicate that additional nitrogen is needed. Spring bulbs apparently suffer less than plants that grow throughout the summer. In my garden lilies and garden vegetables have suffered most from a sawdust mulch.

A sawdust mulch is applied in the fall or during the winter when the snow is not too deep. A mulch an inch or so deep is enough for crocus, but the daffodils and larger plants get 3 or 4 inches, for the material settles considerably by spring. Blueberries and other shrubs will benefit from an even deeper layer.

Any kind of sawdust is suitable, be it hardwood or softwood, fresh or rotted. Shavings are good too. Similar materials which might be suitable but which I have

Among other advantages, a mulch keeps soil in the garden where it belongs, instead of being tracked into the home or being splattered on low-growing flowers and vegetables. Surrounded by a mulch of wood shavings, this squash plant is glistening clean.

Baled hay which has spoiled for feeding purposes is an ideal mulch material. Large pieces can be easily torn from the compressed pads and laid between rows of plants.

Gilman photos

not tried are excelsior, balsam wool and wood chips, sometimes available from tree companies which now grind up prunings with a wood chipper instead of hauling them away to be burned. (See page 40.)

Second Choice

Tree leaves are second on my list of mulching materials if enough are available, because they are so easy to collect. In addition to the leaves from my own trees, I use ten to fifteen large truckloads each year. They are used mostly around shrubs and small trees where their smothering effect is not harmful. Around the shrubs they are piled to a depth of 8 to 10 inches. But twelve months later, they are quite well rotted. A leaf mulch conserves moisture very well and no weeds emerge except bindweed. The principal difficulty I've had with a leaf mulch is the Norway maple seeds that are contained in it. Literally thousands of seedlings push their way through the leaves. Raking the leaves will destroy many of them, but usually I control them with a chemical brush-killer in oil, being very careful not to get it on the stems of shrubs.

Tree leaves are very good for mulching rhubarb. I pile stalks of sweet corn around the plants and then cover them with several inches of leaves. This, plus a liberal application of a 10-10-10 fertilizer, produces a big crop on a small area.

I also save enough leaves to mulch the vegetables and the more robust annuals. Tomatoes should always be mulched. Under clean cultivation the variable moisture supply often results in blossom-end rot affecting many of the first fruits. Mulched plants have few, if any, rotten fruits. The leaves are spread around the plants when they are staked or when the first blossoms appear.

Other Materials

Hay is third on my list. I grow my own and fertilize it heavily to get as much as possible. It is spread mostly around the young trees and shrubs and around the tomatoes. The hay looks good and provides lots of nutrients, but it rots fast. Fruit growers use rain-spoiled hay, which is no longer suitable for cow-feed. It may be had cheaply, in some localities just for the hauling. Near the coast, marsh hay is used very successfully as a winter mulch for strawberries, but it is a good growing-season mulch, too. However, it may be rather expensive.

Wheat, rye, and oat straws are standard mulches for the strawberry bed, and when obtainable in quantity at reasonable prices, are often used also for fruit trees.

Peat moss is one of the best materials for the more conspicuous areas of the garden, where appearance is important. Buckwheat hulls are good-looking and a satisfactory mulch. Spent hops are considerably less dressy, but make a good mulch, and the beery smell soon disappears.

Out where the tall corn grows, ground corncobs have been used for roses, for which they are highly recommended. They are undoubtedly good for most other garden plants as well.

About twenty-five years ago mulch paper was tried extensively, but it soon lost favor. Recently black polyethylene film has been proposed as a mulch for vegetables and strawberries grown in rows. Preliminary reports from California indicate that the plastic film is satisfactory. Berry rot is decidedly reduced and weed control is nearly complete. Vegetables that require much heat, especially tomatoes, peppers, eggplants, cucurbits (cucumbers, squash and melons), and sweet corn, should respond well to a polyethylene film mulch, which is apparently more durable than mulch paper. (See page 43.)

Aluminum foil has also been used experimentally as a mulch for vegetables. Flat stones have been used by some; they certainly are durable, and effective in conserving moisture, but troublesome weeds grow between the stones. In the rock garden stone chips can be used and are recommended.

MULCHES FOR LOOKS

How to select them for aesthetic appeal as well as practical value

Helen S. Hull

THE question in gardening today is no longer whether to mulch, but with what material, what procedure, and for what special purpose. Choice of mulches for the home garden may involve considerations that do not obtain for the experiment station, the commercial flower-growing area, the vegetable farm or even for public parks or botanic gardens. For the home garden the mulch must satisfy not only the basic requirements, but it also should be pleasing to the eye, enhancing the garden's appearance. Furthermore, the mulch should be consistent with the character of the planting.

Those who wish to surround their flowers with ground-up corncobs, or matted peat moss looking like a blanket of old felt, or tar paper, or aluminum foil, or strips of black plastic, or sawdust or wood shavings are, of course, free to do so. These materials all accomplish the purposes of a good mulch; they will be satisfactory economically and horticulturally. They will save weeding and keep the ground moist; the flowers will be gorgeous. But the garden will be ugly.

The home gardener on the other hand considers over-all garden beauty as an inseparable concept. Beauty in the home garden requires good and suitable varieties of plants well grown and well arranged in a pleasing setting and with further regard for garden housekeeping. Mulches must be selected as factors in the aesthetic enjoyment of the garden as a whole.

Use More Than One Mulch

It is inevitable that one kind of mulch won't do everywhere. It would be monotonous, and for various types of plantings it would be either unsuitable or incompatible.

In my own garden there are more than a dozen different kinds of mulches, including buckwheat hulls, leafmold, compost, pine needles, sand, stone chips, grass clippings, hay and, in winter, oak leaves and strawy manure. I also use what I call "living mulches"—ground-hugging plants like thyme (*Thymus vulgaris*), myrtle (*Vinca minor*), pachysandra (*Pachysandra terminalis* and *P. procumbens*) and Johnny-jump-up (*Viola tricolor*).

Buckwheat hulls seem right for the formal rose garden in summer and for some perennials, although in winter strawy manure goes between my rose bushes and on the vegetable garden. In spring the strawy manure covering the vegetable patch is plowed under and in June grass and hay are spread around the tomatoes, between the rows of beans and other vegetables and under the strawberries.

Nothing seems so logical a summer mulch for the wildflower garden as leafmold. It is applied after the winter mulch of fallen leaves from the trees above has been removed. Plants growing under pine trees are mulched the year around with fallen needles. Sand and small stone chips are used for some rock plants in the sun and for native cactus. The ground covers, myrtle and pachysandra, are planted around broad-leaved evergreens and over daffodils. Common thyme keeps the weeds out of a planting of iris and day-lilies.

Johnny-jump-up is a pretty cover for a nursery bed not in use. This low plant flowers and seeds all during the growing season; a few plants soon make a dense cover. When the space is needed for other plants, the Johnny-jump-ups are pulled up and tossed on the compost heap, a poor reward for discouraging weeds and keeping the soil moist.

Buckwheat Hulls for Roses

Because of their soft brown color and pleasing texture, buckwheat hulls enhance the neatness and beauty of the rose beds. My experience with this material dates back to 1940, when a firm sent me a 50-pound bag as a sample. Over the years I have become convinced of its many virtues as a mulch, in addition to its being light and easy for a woman to handle. Buckwheat hulls can be thrown on with a scoop, leveled with a rake and removed with a hoe.

In spite of their lightness, they do not blow in the wind. They do not readily absorb water, but they do let water through and prevent its evaporation. Covered with a $1\frac{1}{2}$-inch layer of buckwheat hulls, my garden needs a good soaking only every ten days or two weeks, even in midsummer drought. The moisture in the soil can be checked easily by simply pushing aside the mulch and looking. When water is applied at ground level with a garden gadget such as a wand or similar hose attachment, the mulch lifts sufficiently to allow the spread of water over the bed, yet lessens runoff. Keeping moisture constantly available is one of the secrets of producing fine roses, but using water wisely is a comfort where water is scarce or expensive.

Compact, low-growing plants such as thyme can be used as a living mulch.

It is my practice to remove the hulls in the fall, dry them in the sun and store them in bags over the winter for use again in the spring. Occasionally, when the season overtakes us, the hulls are left

Roche photos

Johnny-jump-up (*Viola tricolor*) is a colorful living mulch.

Buckwheat hulls have neat appearance and good general mulching properties, making them ideal for show beds.

on; then, after soil or compost has been heaped around each bush to a height of about 10 inches, the usual winter mulch of strawy manure is put on top. The following spring the hulls are removed with the manure and added to the compost heap. Fresh buckwheat hulls are spread on the rose beds in April after a light cultivation and an application of 5-10-10 fertilizer. Subsequent fertilizer is applied in liquid form—a foliar spray plus one midsummer "drink" applied by drawing a 10-inch circle in the mulch around each rose bush and pouring the liquid directly on the soil.

One plantsman has offered the opinion that my practice of removing the old mulch in fall or spring and then replacing at least a top layer of fresh hulls each year, is responsible for the dearth of soil-borne diseases on my roses. This opinion is in the nature of an educated guess. Other factors, such as a weekly spray program or seasonal conditions, might also contribute to the good results. It is true, however, that after watering the roses or after a rain, the top layer of the buckwheat hull mulch dries quickly; this might discourage diseases which thrive in dampness.

Buckwheat hulls are slow to deteriorate, taking two or more years to decompose. This is an advantage in cases where the mulch is not to be dug under. Al-

Though small and light, buckwheat hulls do not blow about badly in any except the most violent winds.

Roche photos

though buckwheat hulls are organic and will eventually combine with the soil, at first, when mixed with soil, they will act about like cinders. Therefore, if the soil structure is already satisfactory, it is better to remove them than to dig them in. Buckwheat hulls would not be a desirable mulch in the vegetable garden. There it is easier to mulch with a material which can be dug in, one which will quickly decay, such as manure or grass clippings.

In the perennial border buckwheat hulls are neat and compatible. But if annuals are added, it is better to shade the soil by planting the annuals close together than to rely on buckwheat hulls, for they may make conditions too damp for soft-stemmed annuals such as petunias.

Buckwheat Hulls for Tuberous Begonias

Buckwheat hulls are especially useful as a mulch where tuberous begonias are planted directly in the soil rather than in pots. One bed on the south side of my rectangular rose garden is under two apple trees which are cherished for their fragrant pink blossoms in April. This bed is too shady for roses, but by trimming the branches of the apple trees high, the light and cool breezes are favorable for tuberous begonias planted underneath. These tender, naturally cool-weather plants are heavy feeders and for

Tuberous begonias flourish in moist cool soil. Buckwheat hull mulch helps maintain these conditions and keeps low-hanging blossoms clean.

good bloom, growth must not be checked. The soil should be cool and moist to make nutrients constantly available but not soggy, as this will encourage rotting of stems and tubers.

In the climate of northern New Jersey buckwheat hulls have proved ideal for keeping soil temperature and moisture favorable for tuberous begonias, and to protect the roots which grow from the tops as well as the bottoms of the tubers. Besides these horticultural advantages, buckwheat hulls improve the neat appearance of the bed. Perhaps best of all, the hulls are clean and on days of rain blossoms will not be ruined by spattered mud.

Leaves and Leafmold for Wildflowers

Whereas buckwheat hulls just suit the looks of the rose beds, they strike a false note in the wildflower garden. Here nothing seems quite right but leaves from the trees above. Oak leaves fall to cover the wildflower garden in winter. In spring they are removed and replaced with an inch-deep layer of leafmold made from leaves of former years. The leafmold is inexpensive and neat and allows even the smallest flowers such as trailing arbutus, Dutchmans-breeches, hepatica and partridge-berry to be seen and enjoyed. In midsummer another 1-inch layer of leafmold is added, and if the season is dry still another layer is added where needed.

Where any work necessary to good culture can be reduced or eliminated by the use of mulches judiciously applied and chosen with respect for their appropriateness and their looks, a gardener's time can be freed for other activities—more areas can be managed for a garden and more kinds of plants can be well grown and enjoyed.

MULCHES AND PLANT DISEASE

Mulches inhibit some diseases, encourage others and act in both capacities for some

Cynthia Westcott

A primary advantage of any mulch that is reasonably fine-textured (without the large air spaces of a material such as tobacco stems) is that it provides a mechanical barrier between old infected leaves on the ground and the growing leaves above. And if the mulch is applied early enough and is combined with an adequate spraying program the plants may remain disease-free all season. In such a case the mulch may stay in place from year to year, added to as necessary. But if disease develops despite protective measures, and spotted leaves drop down on top of or into the mulch, then it should be removed at the end of the season and replaced with fresh the next year, a process that may be both arduous and expensive.

A second advantage of a mulch is that it breaks the force of falling rain or water from the hose, preventing much of the splashing that spreads fungus spores or other infective materials. And, of course, the mulch helps to hold this moisture in the soil and so aids in the survival of those plants which may have lost some of their root systems to disease.

Rose Blackspot

Rose blackspot is a disease that can often be reduced in extent by the use of a proper mulch. I usually mulch my rose garden in New Jersey before May 1st with buckwheat hulls (sold under the trade name, Mul-tex), applied 1 inch deep. The hulls are sold in 50-pound bags, one bag covering about 60 square feet, or perhaps a bit more, at the recommended depth.

I tried cocoa bean shells (Cocoloam) this past summer. They seemed to be equally effective and attractive and the chocolate odor disappeared after the first week. However, the 50-pound bag did not spread quite so far. Ground corncobs are effective but more conspicuous.

These three materials let rain penetrate quickly to the soil below and prevent splashing. Peat moss, on the other hand, takes up a lot of the moisture for itself and, if allowed to dry out too much, cakes on top so that rain falling on it spatters almost as much as when it hits hard soil.

The summer spores of blackspot fungus are never spread by wind alone. In hurricanes they may be carried several feet by wind-driven rain, but normally they are disseminated only as far as they can be splashed, either from ground to overhead leaves, from one bush to the next, or from cane to leaf. Here in the Northeast the fungus lives over winter in inconspicuous spots on canes as well as in old leaves on the ground.

A mulch, therefore, is only one part of blackspot prevention. A dormant spray of 1 to 9 liquid lime-sulfur applied right after spring pruning, plus weekly spraying with a fungicide during the growing season should accompany a mulch. With this three-part prevention program I have completely eliminated blackspot from a garden having a high percentage of infection. But without a mulch I have never quite succeeded in eliminating all blackspot from a severely infected garden.

A very loose mulch, such as unchopped tobacco stems, will catch and hold a lot of infected leaves. Unless it is removed and burned at the end of the season it may cause more trouble than would bare ground, where old leaves can be readily raked up.

Mulching chrysanthemums usually helps in the fight against leaf nematodes, which

Applying buckwheat hull mulch to rose bed. A fine-textured material such as buckwheat hulls is best where disease is a problem, as it does not conceal fallen bits of diseased plant material which can spread infection.

McFarland photos

Tobacco stems are a good mulch for some plants and their nicotine content checks certain insects. For roses they are less desirable because their coarse texture permits diseased leaves and stems to fall into the mulch, beyond the reach of fungicide spray.

swim up the stems in wet weather, causing blighting of the foliage from the ground up. Mulching may also help boxwood which has lost some of its roots to the meadow nematode and must conserve every bit of moisture to survive.

Disadvantages

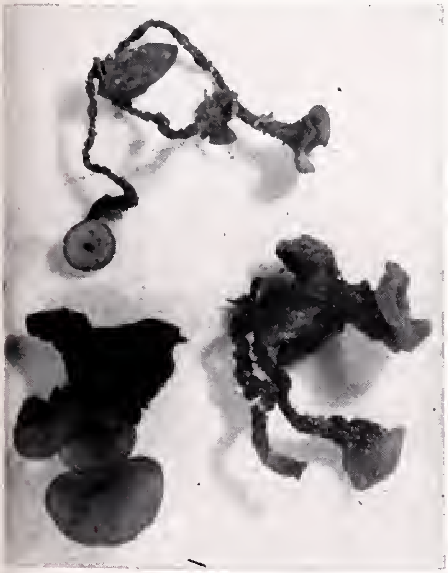
On the debit side a mulch may be harmful in that it may retain too much moisture and so encourage growth of fungi or bacteria. Several times I have investigated rhododendrons with dying branches, expecting to find borers at work, only to find that the trunks were rotting at the base because too many wet leaves had been piled against them. Oak leaves, because they do not mat together so much, are a better mulch material than leaves of most trees. Many rose cankers are fostered by hilling the bushes for winter with leaves, manure, peat moss or even buckwheat hulls. A friable soil is the only safe winter mulch for roses. However, in the New York City area a winter mulch is usually unnecessary. The summer mulch can be left in place over winter unless it is full of diseased material, but it should never be mounded up around the canes.

The fungus fruiting bodies that start the new cycle of rose blackspot and other leafspots are formed in the leaf itself. When the leaf finally disintegrates, the fungus does not live free in the soil. There is another type of fungus that survives after the infected petal, leaf, or stem rots into the soil. It lives on, for one or several years, in the form of a hard resting body, called a sclerotium. In spring, in the presence of sufficient moisture, one or more little stems grow out of this sclerotium, each expanding at the top into a cup, called an apothecium. This is lined with sacs, each containing eight spores. When there is a change in humidity, the spores are literally shot into the air and carried by air currents to susceptible plant parts overhead. A mulch helps to provide the moisture necessary for the formation of these apothecia. If the mulch is very thick the little stems may not be able to penetrate it, but if it is uneven the fungus just puts out longer stems in the thin places and fruits at the surface of the mulch.

Flower Blights

The azalea and camellia flower blights, now so important in gardens from Virginia southward and a potential menace to northern greenhouses, are caused by the type of fungus just described. During the early studies of azalea petal blight all sorts of mulches, including sugar cane, pulp, alfalfa meal, pine needles and asphalt paper, were tested. All inhibited the development of apothecia to some extent; but none delayed the appearance of blight more than a day or two, for the azalea fungus produces another type of spore in the petals and these are soon spread long distances by insects. A single, unmulched plant in an entire town is sufficient to cause a tremendous amount of secondary infection; hence, spraying the flowers often enough to keep all opening petals protected with fungicide has proved to be the only practical method of control.

Author photo



These mushroom-like bodies (apothecia) of camellia flower blight produce millions of spores which spread the disease.

The camellia flower blight, which is becoming a very big threat in all the South, has no secondary spore stage; theoretically it might be possible to control it with mulches. However, the sclerotia are very large and can live in the soil and produce apothecia for at least three years. Also they produce stems long enough to poke through any mulch except an impervious one such as asphalt paper. So, in this case also, mulch encourages disease by helping to provide the moisture necessary for development of apothecia. I have collected a thousand apothecia from the leaf litter under a single camellia bush. Each one shot off so many spores that, in mass, they looked like thick clouds of cigarette smoke (individual spores are not visible to the naked eye).

Camellias bloom for such a long period that it has not yet seemed practical to try to control the blight by spraying the flowers. Some cities have taken such drastic measures as removing all flower buds from the camellia plants on all infected properties for at least two years. Other cities are requiring the weekly removal of all fallen blossoms and are treating the ground chemically to inhibit the development of apothecia. With a mulch of loose litter or a "living mulch" of ivy or other ground cover it is practically impossible to find and collect the thousands of fallen flowers. It is equally hard to get thorough distribution of the chemical. I have followed along after a spraying machine, getting down on my knees to look under the mulch. In many cases the fungicide has merely rolled off the top of the mulch, leaving large areas of the soil surface underneath unprotected.

If it has seemed wise to point out one or two drawbacks of mulches it is by no means my intention to discourage their use in most instances. I think I'd stop gardening if I had to do without a summer mulch, for in my garden it eliminates 90 per cent of the weeding and more than half of the watering.

MULCHES AND THE SOIL PATTERN

Joseph A. Cocannouer

NO matter what type of gardening one may be doing, there is a place for a vegetable mulch. It cannot be overemphasized that in dealing with the soil the aim should always be to build and maintain nature's complete soil pattern in so far as it is possible. This really demands a surface mulch. Nature has a definite soil pattern and if there is no interference with the natural scheme of things, this pattern holds wherever vegetation is produced: a soil mass consisting of two zones, commonly known as the surface soil or topsoil and the subsoil, and on top of these, a vegetable mulch or organic covering. Together these divisions make up the soil "world"—a world teeming with living things, whose combined activity enables the soil to maintain the growth of plants. This is the situation where nature operates without serious interference.

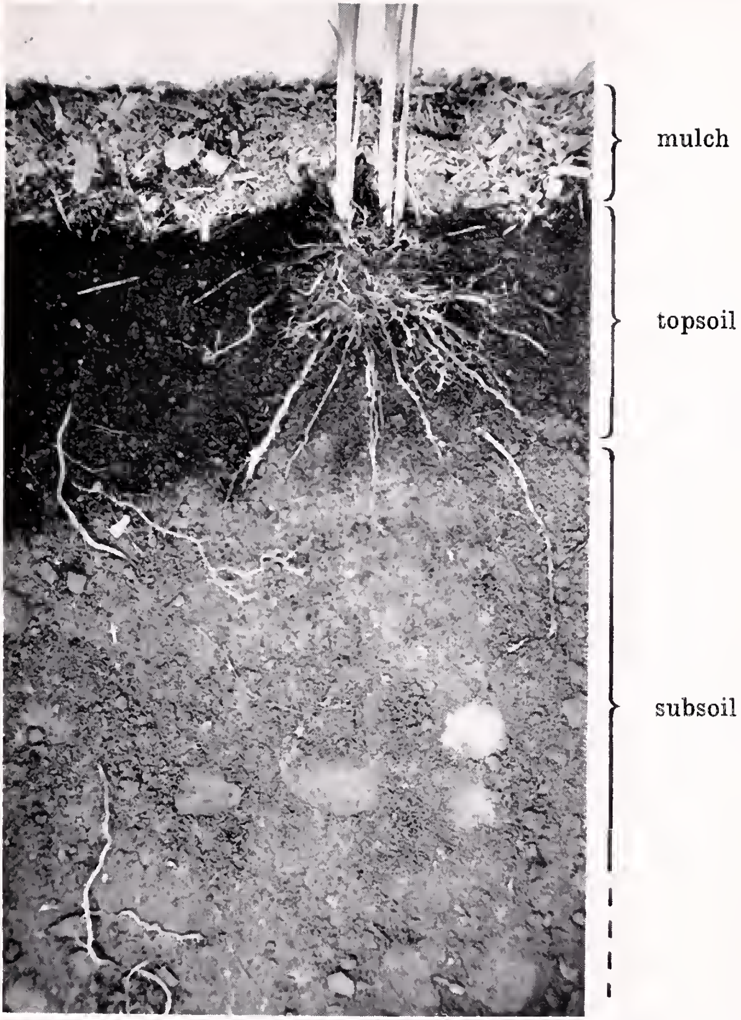
It is an unfortunate fact that the soil is not always able to operate at maximum efficiency, even in regions unmolested by man. Fire and water are two of the natural agencies which can interfere with constructive activities in the soil.

Few people understand what an enormous part an efficient mulch plays in nature's scheme, where the natural mulch is indispensable. The fact that a mulch is not found under all plants does not affect the fundamental truth. The organic litter on the forest floor, for example, is the storehouse from which the topsoil obtains many of its growth-supporting ingredients. The dead remains of once living things gradually decompose, returning to the earth to be used again in the continuous sustenance of life. Aside from this basic cycle the mulch has other important attributes, discussed in accompanying articles.

In nature there is no soil tillage, no soil disturbance, save for what is done by the earthworms, insects, and plant roots. But man, in producing crops, must do considerable stirring of the soil. Necessity requires that he make some changes in nature's pattern. This he can do constructively. For one thing, he should hold his tillage to the absolute minimum essential for preparing a seedbed and for adding the vital organic materials to the lower soil. In short, a deep, rich surface mulch should be maintained without much digging below it.

The very best mulch a gardener can use is one closely resembling that which nature provides: dry weed stalks, twigs and other organic debris, broken up and mixed with dead leaves. This natural mulch can be improved through the addition of compost or well-rotted barnyard manure. Such a mulch applied around shrubs, orchard crops and vegetables, *and maintained continuously* will produce both quantity and quality of crops not possible where the mulch is omitted. The mulch must not be applied for a while and then removed or turned completely under. It must be left in place and constantly added to. As it decays its nutrients will leach into the soil.

No matter what type of vegetable mulch one may employ—and many kinds are satisfactory — one should maintain the mulch continuously. This is the way nature does it.



Relationship between mulch and topsoil. Topsoil is, in a sense, constantly being "used up." Its minerals are being absorbed by roots of plants and its organic material (the dead remains of plants and parts of plants) is in a state of continuing decay. If the topsoil is to retain its quality, these constituents must be constantly supplied anew. Mulching is one means of doing this.

MULCHES FOR SEASIDE GARDENS

They may spell the difference between success and failure

Frederick F. and Esther Rockwell

MULCHING plays an important part in gardening in almost any climate and under all sorts of conditions. At or near the seashore, where temperatures are likely to be considerably above those inland, and where alternate freezing and thawing occurs more frequently, winter mulches are doubly important. Moreover, the predominance of light sandy soils, which dry out quickly, and frequent periods of summer drought add to the necessity for summer mulches.

Under such conditions the use of mulches during both winter and summer plays a large part in successful gardening; in fact, with many plants it may mean the difference between success and failure. While our own experience in this respect has been mostly in Cape May, New Jersey, and on Cape Cod, observation leads us to believe that the same holds true along almost any coastline and even on the shores of large inland bodies of water. However, many of the latter are surrounded by soils that are heavier and retain moisture better.

Summer Mulching

The first rule for summer mulching of seaside gardens is *mulch everything*. At least we have found that all our plants have been helped by a mulch, although many of the native or "escaped" flowers, such as lupine, columbine, dianthus and broom, will do without any but that provided by nature. Many native plants such as arbutus—of which we are so fortunate as to possess a couple of acres—and bearberry (*Arctostaphylos uva-ursi*) either grow where trees provide a natural mulch or, as in the case of bearberry, the plants provide their own mulch.

In our flower and vegetable gardens we begin mulching as soon as plants are well established. After pulling all weeds by

In rigorous seaside climates mulches are almost a necessity. The tomatoes in this Cape Cod garden are mulched with salt hay.

the roots, we cultivate the soil surface thoroughly, using a scuffle hoe between the rows and a triangular, all-purpose hoe between the plants in the rows.

Next we apply the mulch, being careful to cover the soil surface to a depth of several inches and to bring the material right up close to the plant stems. An open, well-aerated mulching material may be applied in larger quantities than those that are more dense, such as peat moss. Whether or not the mulch has to be added to as the season advances also depends on the material used.

Summer mulching first of all conserves moisture—one of the greatest needs in sandy-soil gardening. Near the sea we have found that we can grow practically anything if we supply plenty of humus, plant food and water. Of these three "musts," sufficient water is the most difficult to provide, especially during the long dry spells of July and August.

When sudden, heavy storms give us several inches of rain in a very short time, as so often happens at the seashore, a mulch prevents surface runoff and enables the soil to absorb the water gradually. But the same precipitation causes a leaching of plant nutrients from sandy soils. We therefore make small, frequent applications of plant foods rather than the two or three feedings which are commonly applied to heavier loams.

Then, too, a mulch keeps the surface soil from hardening and packing. In dry weather the surface of clay-bearing sandy soils may become almost as hard as cement, making it difficult for plants to grow. Under a mulch the ground stays moist and friable.

The third advantage of summer mulching is that it practically eliminates weeds. The few seedlings which do get a start are tall, spindling and easily pulled out by the roots.

Materials for a Summer Mulch

There are many summer mulches available, some of them free for the gathering. We have used the following successfully:

Green rye straw we gather from our own winter rye cover crop. We permit it to grow 12 to 18 inches high, mow it and use it for mulching, and then dig under the roots and stubble. We mulched our potatoes, tomatoes and vine crops with this material last year.

Pine needles and dry leaves, especially oak, are everywhere around us, and form the natural mulch which protects acid-loving natives such as arbutus and bearberry. We use these to mulch azaleas, evergreens and even the rose beds.

Author photos

Four useful mulching materials—oak leaves, pine needles, excelsior and peat moss.

Gantner

If appearance is not of prime importance, cornstalks can be a useful winter mulch.

Marsh grass or hay, which can be gathered readily, is ideal for mulching strawberries, iris and other perennials, as well as vegetable rows.

Grass clippings can be saved and mixed with dried leaves or rough compost (the large pieces screened from the heap).

For the large vegetable garden we also utilize **cornstalks,** cutting them as soon as the last ears are harvested and laying them lengthwise between the rows.

For our show beds, which we want to look neat and attractive, we still prefer **buckwheat hulls** or **pulverized native peat,** which is usually available somewhere on the Cape. Massive deposits are often uncovered during excavations. For example, a large shop that is being built near us had to dispose of hundreds of tons of peat before it could put in its foundations. Though not as good as imported peat moss, this material is much cheaper and perfectly usable as a mulch.

Winter Mulching

Winter mulches are especially valuable near the seashore, where temperatures change so rapidly. Also, high winds are frequently encountered, so that winter mulching becomes a real necessity.

It is well to delay the application of a winter mulch until *after* the first hard freeze. If this procedure is followed there is less likelihood of alternate freezing and thawing around plant roots, the main cause of heaving and consequent winter injury.

We have not found it necessary to protect the tops of roses and low-growing perennials, as winter winds are laden with moisture and stems do not dry out (except in winds of hurricane velocity). Evergreen shrubs and small, recently planted evergreen trees, on the other hand, need the protection of burlap or straw to prevent wind breakage. Plants

Winter protection is in a sense a form of mulching—mulching carried into the air. Here discarded Christmas trees bundled around climbing roses provide winter protection (trees removed from front to show rose bush).

To prevent heavy snow from breaking light branches as well as to shield it from winter burn, newly planted shrub is protected by old Christmas trees. ↓

Author photos

Cut spruce or pine branches are a good winter mulch in themselves, or can be used to hold lighter mulches in place.

Gantner

in the path of salt spray should also be covered.

Near the sea, where spring may come later and be colder than in adjacent inland areas, it is desirable to keep the winter mulches on as late as possible to prevent too-early top growth which may be touched by late frosts.

Materials for a Winter Mulch

There are many excellent materials near the sea that are suitable for winter mulches. Old Cape houses and also the flower beds surrounding them are banked around the foundations with **eel grass**, an underwater herb with long linear foliage. This material can also be gathered along the salt creeks and bay shores. It and **kelp**, gathered from the beaches, not only make excellent, non-packing mulches but also supply valuable humus and nutrients when dug into the soil in spring. On the Aran Islands off Ireland, potatoes are grown in kelp dragged up from the sea and deposited in the depressions of the rocky ledges which form the islands.

Salt hay, marsh hay, beach grasses and **rushes** are other materials which can be had for the gathering.

Here on Cape Cod **cranberry cuttings,** removed from the bogs in autumn, are widely used for mulching. These pretty clippings form a decorative cover which really improves the appearance of beds and borders.

Pine needles, dry leaves and **pine boughs** are also plentiful. Boughs may be laid over a mulch of needles and leaves to hold them in place and to keep snow and ice from settling about the roots. We find this treatment ideal for roses.

MULCHING PRACTICES AT
THE ARNOLD ARBORETUM

Donald Wyman

IT has often been said that the use of any kind of a mulch on Massachusetts soils is better than no mulch at all, and the Arnold Arboretum grounds have been operated on that principle for many years. There are several factors that govern the kind of mulch we obtain. Although we might prefer to mulch with certain types of materials, budgetary restrictions require that the cost of the mulch be kept to a minimum.

The appearance of a mulch is an important consideration, and nothing should be used that might be objectionable from this standpoint. Although we experience little vandalism here, time has demonstrated that materials like mulching paper, aluminum foil, polyethylene film, and similar materials would be disrupted if placed out in large amounts on the grounds. Moreover, no mulching material should be so dry and light that it is easily blown out of place by wind.

Fire Hazards with Mulches

Fire is the greatest hazard in using some mulching materials. We cannot use materials that are easily ignited by cigarette stubs or youngsters playing with matches; nor do we use any which would burn readily if ignited by grass fires that might creep up to them.

Years ago, one of the valuable dwarf conifer beds was mulched with peat moss. The season had been very dry; the peat was dry. On a windy July day

Nelson

Wood chips are a comparatively new and satisfactory mulching material.

Courtesy Arnold Arboretum

A mulch of spent hops at the base of this tree stopped the spread of a grass fire. Many other mulches catch fire quickly, so care must be exercised to see that they are not placed where passers-by carelessly throw their cigarettes.

a grass fire was started by a horseback rider who had thrown away his lighted cigarette carelessly, and within minutes the peat moss started to burn. Since the evergreen branches touched the peat, only a small flame was necessary to ignite the branches. As a result of this one fire, burning a short 20 minutes before the fire apparatus came, nearly $12,000 damage was done to these plants, some of which were irreplaceable old specimens. The firemen left that afternoon with the fire out, presumably, but the next morning the peat moss was smouldering in many different places. This was proof to us that peat moss was not a good mulching material under our conditions.

Within the last three years, we have been using three kinds of mulches indiscriminately on all plantings on the grounds in the Arnold Arboretum, in addition to generous amounts of sifted, decayed leaf mold which we are fortunate in having available here.

Sawdust and Wood Chips

Sawdust mulch was used experimentally on the cotoneaster collection a few years ago after first fertilizing the plants heavily. The results were good, but we had to buy this material, and since the other materials were obtained without cost, no more sawdust has been used for general mulching purposes, although we do use it occasionally in mulching evergreens and ericaceous materials in the nursery.

Wood chips have, of course, proved successful. After one of the recent hurricanes, a group interested in the Arboretum presented a brush chipper which can be attached to our Ford tractors. Instead of hauling brush to be burned, now we find it cheaper labor-wise, as well as being better for the plants, to chip the brush on the spot and blow it around the base of the trees or shrubs which are nearest the pile. Unfortunately, this is more of a disposal program than a mulching program, so that the chips are blown

Courtesy Arnold Arboretum

If readily obtainable, cocoa bean hulls mixed with sawdust (1 to 3) are a splendid mulch. Note that the mulch is kept away from the tree trunks for rodent control.

on the plants nearest the pile where the brush happens to be. Elm wood is not chipped but hauled away and burned at once, as a precaution against Dutch elm disease.

Spent Hops

Spent hops have proved quite successful. In the winter 1950 issue of PLANTS & GARDENS a note on this was published. We have been fortunate in being comparatively near two breweries which wanted to dispose of their spent hops. They could be obtained merely for the hauling at regular intervals. These hops had the following analysis:

Water	87.67%
Nitrogen	.40%
Organic matter	11.49%
Ash	.49%
pH 4.8	

This material has been used now for over ten years. There are several drawbacks to it. In the first place, it is obvious that as obtained from the brewery, it has an extremely high water content. (For every 238 pounds of dry material, we were hauling 1,740 pounds of water.) It also has an objectionable odor, which is noticeable on a warm day but disappears in about two weeks. Thirdly, we have noticed that it attracts pigeons and rodents.

The merits of spent hops far outweigh its disadvantages as a mulch as we use it. It costs us nothing but the labor of hauling. It is wet when first applied, hence does not blow away on a windy day. And, what is most important, even when dry (after weeks of drought), these hops will not burn appreciably. Time and again it has been noticed that plants mulched with spent hops have not been injured from surrounding grass fires. The fire has burned up to the edge of the mulch and stopped. Because of this, we have actually used this material in mulching as a fire preventive.

Although slightly more acid than our soil, the spent-hops mulch has been applied to practically all the kinds of trees and shrubs in the Arboretum except a dozen of the outstanding lime-requiring plants. We have seen no ill effects from its use except when applied on days preceding high temperatures, and when the hops are heaped around the base of a small tree trunk or a shrub with numerous stems. When this occurs and the temperatures are high, the material does heat noticeably and can kill stems several inches in diameter. Hence, the only precaution to be taken in applying this material is to keep it a foot or so away from the basal stems of trees and shrubs.

The spent-hops mulch is applied 4 to 6 inches thick and lasts about two years before disintegrating appreciably. Quackgrass and other weeds will eventually grow through it. This mulch is ideal for conserving soil water and has necessarily been applied at all seasons of the year.

Cocoa Shells

A cocoa-shell mulch is the third mulching material, and we have been experimenting with this for the past year. This, too, has come as a result of economic pressures of various sorts. The breweries have discontinued, hence no more spent hops are available within reasonable hauling distance. Two manufacturers of cocoa products have had their sales for the cocoa shells stopped suddenly for various reasons, and since the Arnold Arboretum is willing to haul them away, they are given to us intermittently for mulching purposes.

Cocoa shells as a mulch may have drawbacks which are not as yet fully known to us. They do have a chocolate odor, when first applied. When fully saturated with water, they will heat up on a warm day and because of this, precautions are taken to keep them a foot or so from the trunk or basal branches of the plants. A mold grows through them quickly in warm weather, but as far as we can determine, this is not harmful to the plants. Finall after serving several weeks as a mulch an after having taken up water, they ar disagreeable to walk on, being ver slimy, and later the surface may tend t cake. (See page 34.) This might b one of the reasons the home garden would not desire this material about h plants.

Like spent hops, a cocoa-shell mul (to us, at least) has its good points. W obtain this material merely for the hau ing. As the cocoa shells come from th factory, they are extremely light and dr and so, very easily applied. In ever ton of cocoa shells there are only 2 pounds or less of water. Even more in portant, there are 54 pounds of nitroge and 1,878 pounds of organic matte Hence, cocoa shells can be considered n only as a mulch but as a fertilizer as wel since some commonly-sold fertilizers co tain less nitrogen.

The cocoa-shell mulch is being applie indiscriminately to all the many planting in the Arboretum. The pH is 5.5, abou the same as the soil; phosphorus conten is 1.1 per cent, and potash, 3.7 per cen As a mulch, the cocoa shells are applie about 3 to 4 inches thick. Weeds do hav a habit of eventually growing through however, these weeds can be remove easily if prompt attention is given th eradication program as soon as they a pear.

The appearance of the cocoa-shell mul immediately after application is a un formly pleasing brown color, after severa months turning to black. Work at th Pennsylvania State University showed tha when cocoa shells are incorporated int the soil, their effects as measured b greater growth of grass on a golf cours are evident for at least four years. Ho this mulching material will eventuall work out in the Arnold Arboretum re mains to be seen, but as a mulch it shoul be effective several years. Certainly, has more fertilizing value than any mulc ing material we have used recently, an so, economically, it can prove a very d sirable stimulant to plant growth.

MULCHING PRACTICES AT LONGWOOD GARDENS*

Everitt L. Miller

IN order to perform its most important function of insulation, a winter mulch must have air spaces. That is why we at Longwood Gardens find the following materials the most satisfactory: oak leaves, pine needles, strawy manures, mushroom manure, wood chips and cypress needles. Under average conditions such a mulch ought to be 3 to 4 inches deep over the soil surface; this will protect the plant and prevent freezing and thawing. If we did not mulch, the shallow fleshy-rooted plants and the seedlings transplanted so late in fall as to be unable

Because of their light weight and fine texture, buckwheat hulls are an ideal mulch for small plants such as pansies.

Hampfler, Longwood

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*Established by the late Pierre S. du Pont at Kennett Square, Pennsylvania in 1906, the gardens are now operated by the Longwood Foundation, a non-profit foundation created by Mr. du Pont in 1947. The gardens are open free of charge to the public every day of the year. More than 300,000 visitors come to Longwood each year.

Mulching a perennial bed with strawy manure.

Singer

to produce roots would heave from the soil. Their roots would be exposed to the drying winds and extremes of cold which are fatal to most plants.

Longwood's **perennial borders** are entirely covered with a 4-inch mulch of either strawy stable manure or mushroom manure in the early part of December. This mulch helps prevent the perennials, biennials and bulbs from heaving out of the ground. It also adds organic matter to the soil as it decays. In early spring the bulky and strawy materials that are left are removed and saved for a summer mulch, as described below.

Our **pansy beds**, composed of plants grown from seed and planted in outside gardens during September, are also mulched. After the first freeze a light covering of buckwheat hulls ½ to ¾ inch deep is applied to the whole bed. Should some of the pansy foliage become covered with the buckwheat hul during application, a light sprinklin with the garden hose will wash the free, or this may be left for the firs light rain. We favor buckwheat hulls o pansy beds because they are very ligh small and fluffy. They can be handle very easily and work in around the bas of the plant well; they also give a ne and clean appearance. This mulch i left on the bed until the plants are take away in the spring. By this time wha little material is left is worked into th the soil.

English ivy, when grown as a groun cover at Longwood, is given a winte cover of evergreen branches during th month of December. Enough cover i applied to just hide the ivy. This materia is removed when the gardens are cleane up in the spring. The purpose of thi mulch is to keep the ivy leaves from turning brown.

After the first frost in the late fall the beds of *Eremurus* are covered completely with 8 to 10 inches of bald-cypress (*Taxodium*) needles. This material is readily available from specimen trees growing in the Gardens; cypress does well in our climate, and even further north. After a snowstorm or a few rains, the cypress needle mulch packs down to a depth of about 6 inches. It is removed in mid-March and saved for a summer mulch. We prefer the cypress needle mulch to straw, other leaves, etc., because it is light and fluffy, besides being readily available here.

Peat moss and white pine needles are preferred at Longwood for **ericaceous plantings** including azaleas and rhododendrons. The peat is used 1 to 2 inches deep over the planting area during the spring, summer and fall. It not only acts as a mulch but adds organic matter to the soil. During December a 4-inch mulch of white pine needles applied over the peat serves to give extra protection during the winter months. We also use white pine needles around any shrub or tree plantings. Studies show that they will not absorb moisture from the ground, but will allow the rains to pass through. Pine needles are easy to handle, good in appearance, and after decomposition increase the acidity of the soil.

On some plantings of azaleas and rhododendrons wood chips are used when available. When using either wood chips or sawdust it must be remembered that they usually cause a nitrogen deficiency, which may be corrected by adding nitrogen to the soil in either fall or spring (see page 52).

Summer Mulches

Summer mulches are used at Longwood to cover surface-feeding roots, to keep the soil cool, to conserve water, to control weeds, and to add organic matter to the soil.

In mulching **boxwood** hedges (and other plants) a 4-inch mulch of either mushroom manure (readily obtainable in our locality) or white pine needles around the base of the plants has been successful. This material is allowed to remain around the plants and is added to as needed.

In **garden areas** where annuals, perennials, and biennials are grown in rows for display purposes or for cut flowers, we mulch 3 to 4 inches deep with material left over from the winter mulch (or any strawy material). In some cases the white pine needle mulch mentioned above has proven satisfactory.

For **newly transplanted trees and shrubs** a 4-inch mulch of mushroom manure, white pine needles, wood chips, or any of the strawy materials, applied soon after transplanting has proven extremely beneficial. Such a mulch is permitted to remain until the plant is established.

To prevent winter-heaving of newly transplanted shrubs, Longwood practice is to use a mulch of oak leaves with a cover of salt hay.

Hampfler, Longwood

MULCHING PRACTICES AT

THE BROOKLYN BOTANIC GARDE

Alys Sutcliffe

SEVERAL mulches have been used in different parts of the Garden in the past few years.

Cocoa bean hulls (cocoa shells) have been used extensively since 1952, both alone and mixed with sawdust. The latter is the preferred way of using them (⅔ cocoa bean hulls, ⅓ sawdust), applying a layer 2 to 4 inches deep. The hulls help to color the sawdust and the sawdust helps to break up the cocoa hulls which when used alone are apt to cake and become moldy. Cocoa hulls supply a small amount of nitrogen. The lilacs and the viburnums, where applications have been liberal, have made considerable foliage growth and looked much healthier after use of this mulch. The strong smell of chocolate disappears in a week or so after the cocoa hulls are applied.

Sawdust has been used for a number of years in the nursery and on the grounds. Most of it has been cedar sawdust. It is slow to disintegrate and therefore does not use up nitrogen so quickly that plants are affected. In fact, there has been no trouble on that account except in the case of *Ilex crenata* var. *convexa*, which was the only shrub that was noticeably sensitive to any lack of nitrogen. Over the years the soil texture has become much improved. Cedar sawdust is very white and rather glaring for the small garden, but is not objectionable as a mulch for shrubs. A darker brown sawdust of red cedar or redwood is obtainable as a mulch for shrubs. These make better-looking mulches.

Peat moss is still a favorite and a goo mulch. It must not be allowed to d out, and should be thoroughly dampen before spreading on the garden as it a sorbs a great deal of moisture (see pa 64). It is easy to procure and use a is also nice looking. Although of no fe tilizer value, it is a good soil condition if gradually incorporated into the so When used regularly on flower beds may result in too great acidity. Th can be prevented by adding about pound of ground limestone to each bush of peat moss. This is unnecessary whe mulching rhododendrons and other eric ceous plants.

Buckwheat hulls (trade name, Mul-tex are the most expensive mulch at t Botanic Garden because of freightag Buckwheat hulls are used here chiefly i the rose garden. They are an excelle mulch, put on about 1 inch deep. The absorb little or no moisture from the soi yet allow rain to go through freely t the soil beneath. Also, because of t dry, shell-like consistency, weed seeds d not germinate in them as they do in pe moss. Buckwheat hulls should be applie to rose beds in the spring after the firs fertilizing and while the ground is sti full of moisture. In this way no furthe watering will be necessary except durin a very dry summer or on a very sand soil. Annuals and perennials may b mulched when well established and afte their first feeding. Recommended rat of application for most purposes is o 50-pound bag to 65 square feet of groun which gives a covering 1 inch thick.

Wood chips make an excellent mulc

for shrubs of all kinds. They last a long time and water runs through easily. They have been used very effectively on chrysanthemums but are rather coarse for the average flower bed. At the Botanic Garden we produce our own chips from tree trimmings with a chipper.

Oak leaves, when available, are one of the best mulches for rhododendrons. Other partly rotted leaves may be used as a mulch for shrubs and as a winter mulch for flower beds.

Graystone chips and **coarse gravel** are the best mulches for most rock garden plants. They apparently hold the plants down and at the same time prevent water from standing around the crowns of the ground-hugging plants. Chopped oak leaves and peat moss are used for the low-growing rhododendrons and heaths. Mulches are as important in winter as in summer in the rock garden, particularly in regions where there is little snow.

Spent hops have been used in the past; when obtainable they make a very satisfactory mulch and are fire resistant too. (See page 29.)

Before putting on any mulch in late spring or early summer, be sure the ground is completely free of weeds and the soil moist. Most mulches should be at least 2 inches thick to be effective in keeping down weeds and holding the moisture in the ground. As summer season work-savers, mulches are rated very high at the Botanic Garden—in reduction of time that used to be devoted to cultivation, and to watering.

McFarland

Oak leaves are generally regarded as a good mulch for azaleas and rhododendrons.

Nelson

Stone chips are used to mulch alpine plants in rock garden.

Author Ruth Stout spreads thick mulch of hay on her vegetable garden at Redding, Conn.

FOR THE BUSY, THE AGING, AND THE LANGUID

Permanent mulching can solve many garden problems and take much of the hard work out of gardening

Ruth Stout

RECENTLY I received a note from a magazine editor who had accepted an article which described my method of gardening. He ended with: ". . . but frankly we expected more information and not quite so much enthusiasm." I treated this lightly, merely sending him a line saying: "Thank you for buying my enthusiasm."

Shortly after that another editor, upon accepting an article, commented: "I don't quite see why you think you invented mulching." The answer to him went something like this:

"I know that mulching is older than I am, but since my book appeared over a year ago, I have been in touch with two thousand five hundred gardeners. Five hundred of them came to see my garden, some of them from as far away

Lang photos

No plant material is destroyed in this garden. Here Miss Stout pulls cabbage stalks and adds them to thick mulch already in place on soil.

as Florida, Canada, Wisconsin; I have received eight hundred letters; I have talked to more than one thousand five hundred people at garden clubs and I haven't found one person who had ever heard of practicing mulching the way I do except those who had read my book or articles about it."

But it was really the first note which deserved some attention. It makes no difference who thought up this easy method; the important thing is to write about it in such a way that anyone can see the advantages of it. So I will now try to explain exactly what it is.

Making the Mulch

Let us say it's autumn; you have flower beds and a vegetable plot which you have always cultivated in the time-honored fashion, but you now want to adopt an easier way. The first mistake to avoid is that of cleaning up the garden. Leave everything where it is—all annual and perennial dead tops in the flower beds, and in the vegetable section leave every cornstalk, every vine, plant, root. Two thousand years ago a Roman said to make manure of litter, beanstalks, etc. Who paid him heed, I wonder?

Now dead leaves have fallen all around. Rake these up and spread them over your gardens. If they seem inclined to blow away, don't let them; toss peony tops, cornstalks, cabbage roots on them. Rain and snow will help you persuade them to stay put.

In the meantime, try to create a demand for spoiled hay, sawdust or straw by telling your friends and neighbors and

Spring planting is not hampered by mulch, which is merely pulled aside.

Lang photos

Asparagus stalks are left standing at season's end, to become a part of next year's mulch.

garden club about your project. Here in Connecticut, where I have a garden column in several newspapers, hay for mulching is available and inexpensive. Many people are using it.

Spread hay or whatever vegetable matter you can get over your garden, 8 inches deep. Don't be afraid of weed seeds; if the hay is thick enough, weeds have no chance.

Part of the advantage of mulch is that it rots and enriches the soil. Salt hay is all right but it is expensive and rots slowly. Sawdust also rots slowly and so does peat moss, but the latter is said to have little nutrient value.

Now your gardens are covered thickly with mulch of one kind or another. I prefer a mixture of hay and leaves and of course all kitchen garbage except meat scraps. You can tuck the garbage under the hay if the sight of it is offensive. Unless it has been kept in the kitchen too long, it won't smell.

Joseph Wood Krutch, who now lives in Arizona, wrote me: "After reading your book I chose a spot in the garden and put all our garbage there. After two months I found the first earthworms ever seen on this property."

Now spring arrives. All bulbs, peonies, asparagus, will come up through the mulch, although leaves, since they mat down, shouldn't be left piled on these plants too thickly. If you have perennials you're nervous about, pull back the mulch and have a look.

You never turn under the mulch. You never plow or spade either vegetable garden or flower beds. When you're ready to plant anything, just pull the mulch back and put the seeds in. Don't put the mulch back on top of the newly-planted seeds; as soon as they sprout, pull the mulch up close around them, thus holding in moisture and outwitting weeds.

Advantages

The advantages of this method are numerous. There is no plowing, spading, hoeing, cultivating, weeding. No compost pile; your whole garden is your compost pile. The mulch rots and enriches the soil. Except for cottonseed meal, which supplies nitrogen, I've used no fertilizer, not even manure, for twelve years.

And the mulch holds in the moisture. A year ago last summer we had sixteen weeks of drought; my book describing my method came out that August, and visitors flocked to have a look at my garden, to see if the system really worked. As a matter of fact I was afraid the long drought *would* be my undoing but instead it proved one of my points; my garden, which hadn't been watered at all, was thriving while those around us were drying up. It was fun to pull back the mulch and show a skeptic the moist earth and wriggling worms.

Some Questions and Answers

From the letters I receive and the questions asked at lectures, it is fairly easy to guess what questions may arise in your mind. Here are the answers to a few of them:

Q. When do you apply mulch?
A. *Just as soon as you can get hold of some, and after that, whenever it gets thin.*

Q. Aren't some leaves too sour?
A. *If you think so, add a little lime.*

Q. How long does the mulch last?
A. *That depends on what kind you use. Try to always have some in reserve so it can be replenished as needed.*

Q. What is spoiled hay?
A. *Hay that for some reason is not good enough to feed to livestock. It may have become moldy if moist when it went into the hay mow, but it is just as effective for mulching as good hay.*

Q. Do the mulched flower beds look awful?
A. *They needn't. I put a rather thin layer of soil on top. Instead of soil you can cover the hay and leaves with peat moss, buckwheat hulls, sugar cane, pine needles; what you use depends somewhat on how rich you feel. Any weeds that sprout are anemic and easily demolished for their roots are in the mulch, which is full of air pockets.*

Q. Is it worthwhile to mulch in city gardens?
A. *I've no hard facts, but think it may be beneficial in the city because it keeps the soot away from the earth.*

My method takes nine-tenths of the labor out of gardening. I've done it successfully for fourteen years, and I have letters from every state in the Union reporting splendid results. This coming season Dr. Arthur J. Pratt of Cornell University expects to collaborate with me in demonstrating it; he will make some trips here through the spring and summer to watch results. The University of Connecticut also plans to look on.

These tests will be aimed primarily at finding out what is the best fertilizer to add to the soil to supply nitrogen and to see whether anything besides the rotting mulch is needed for best results.

In regard to the method itself Dr. Pratt wrote me: "If good yields can be maintained for ten to fifteen years without plowing or fitting, they probably can be maintained forever on similar soils."

When, like a leaf, I wither, fall, and die, and St. Peter asks me what I've done to deserve to enter Paradise, I will say:

"Well, at the moment I can't think of much of anything. But there's one thing I *have not* done: I have never burned a pile of leaves."

I don't suppose this will get me a preferred seat but I will bet a bale of hay that it will get me through the gate.

MULCHING WITH WOOD CHIPS

Though concerned with holly, these experiences apply to other plantings as well

Kathleen K. Meserve

WHEN man fails to provide a covering for the ground, nature, left to her own devices, usually will. The decision which gardeners ultimately must make is whether to continually battle the effort of nature to provide a cover of weeds, which can so very quickly take over, or to improvise a covering which will satisfy nature and at the same time answer the particular problem at hand.

Under certain conditions it is practical to let nature go ahead and do her job, limiting her only as to the choice of ground cover. There are situations, however, where ground covers are not practical. A holly nursery is one.

There are, in our business, two choices. We can either battle the weeds by cultivating between the hollies, or we can mulch. Cultivating between the hollies can cause damage to the lower branches unless done with great care, and if the job is carefully done, it can cause great damage to the fellow doing it. Furthermore, if cultivation is used it must be continued throughout the growing season. We have found mulching to be the answer.

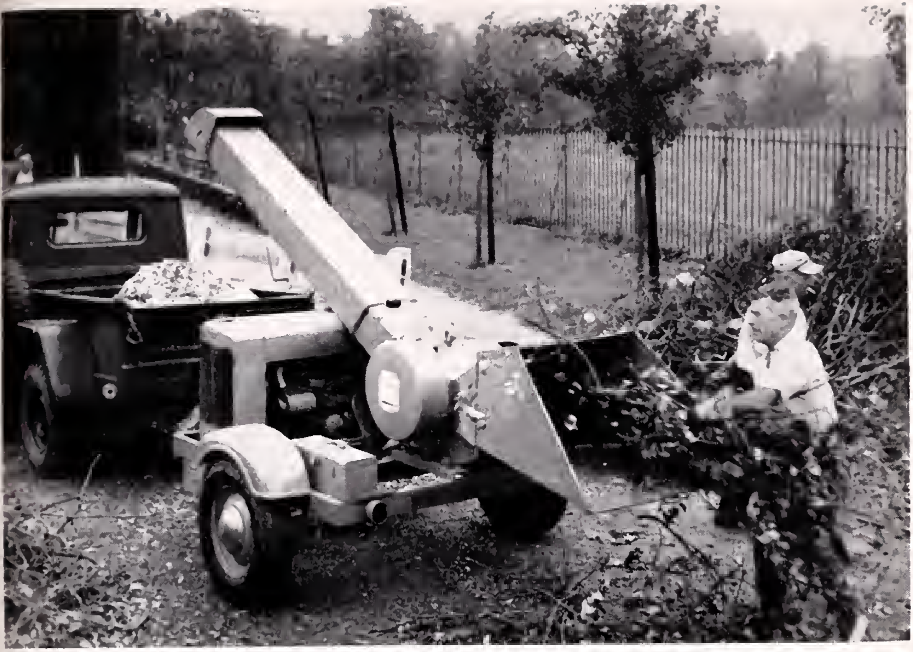
Advantages of Mulching

This was not a difficult decision to make when all the advantages of mulching were taken into consideration. Mulching not only keeps the weeds down but it improves the texture of the soil, whether the soil is light or heavy; after a few years the rotted material adds humus to the soil. It keeps moisture from evaporating during hot winds and droughts, prevents the soil from washing during heavy downpours of rain, and holds the precious rain where it is most needed. It modifies the rise and fall of the temperature around the roots and protects them from any disturbance. Last but not least, it gives us a job to do during the winter and it relieves us of the necessity of continually watering and fighting weeds during the growing season when there are always too many things to do anyway. As for the hollies, they like the mulch and reward us accordingly.

The choice of what material to use for mulch has been equally easy for us to make. We have the Asplundh Tree Expert Company working along our roads. They are engaged by the utility companies to keep the electric and telephone wires free of tree branches. Their orange trucks can be seen in almost every state in the Union, dragging their chopping machines behind them. There are usually three men to a truck and they cut all the dead and dangerous branches off the trees below the wires. These they run through a chipper which in turn blows the chopped material into the back of the truck. When the truck becomes full of this material the men must find a place to dump it.

By arrangement with the Company, the men are allowed to charge a small fee for dumping it on private property. The fee is so small that there is no mulch (including oak leaves free for the gathering) which costs less. Nor do we think there is any mulch which gives more over-all satisfaction. These wood chips come mixed with leaves in the summer and with no leaves in the winter, as one would guess. They vary in coarseness with the number of chopping blades on the particular machine. We put the stringy material on the nursery and save the more refined chips for specimen plants near the house.

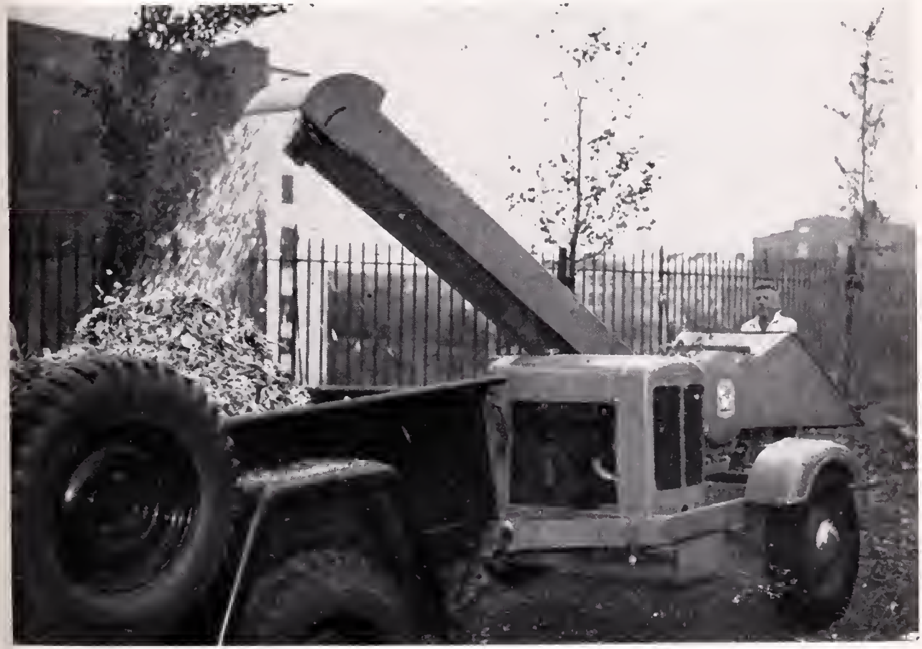
When we plant even a small holly on



Feeding prunings to wood chipper.

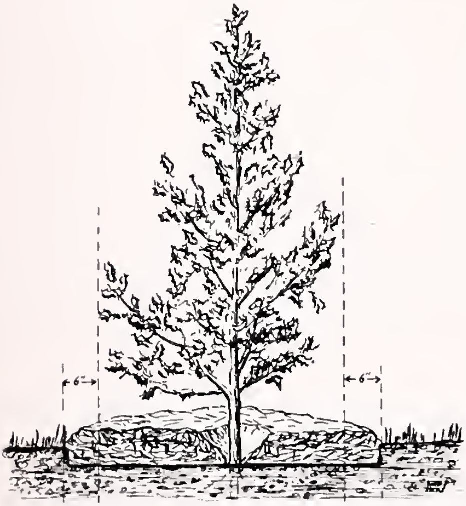
Wood chipper converts twigs and branches up to a few inches in diameter into chips which make a highly desirable mulch, coarser than sawdust.

Buhle photos



our lawn, we remove the sod to form a circle about 4 feet in diameter and 4 inches below the level of the grass. After planting the tree in the center, we fill the entire circle with chips to a depth of about 8 inches, always keeping the chips away from the trunk of the tree,—a protection against mice damage. After a month or two of normal rain the mulch usually settles nearly flush with the grass. One of our winter jobs is to enlarge these circles about 6 inches and add to the mulch. In this way the tree is protected from the lawn mower, and much tedious trimming is eliminated. As the tree grows and spreads, we continue to increase the size of the circle, always keeping it at least 6 inches beyond the spread of the branches. To eliminate any chance of the rotting chips robbing the plants of nitrogen, fertilizer is applied. Never has a nitrogen deficiency showed up which could be blamed on the mulch.

We can honestly say that this mulch eliminates most of the chore of weeding. Few weeds will fight their way through. In order to keep an absolutely clean nursery, it is weeded twice a year and sometimes during midsummer the mulch is added to slightly. There are three weeds in particular which seem to enjoy the increased moisture under the mulch and fight their way through. Their common names are wild chrysanthemum or mugwort (*Artemisia vulgaris*), nut grass (*Cyperus esculentus*) and sour grass (*Rumex acetosella*). When they appear, we try to follow the old proverb of "a stitch in time saves nine" and get after them immediately and thoroughly.



In mulching tree with wood chips, circle 4 inches deep is dug to 6 inches beyond spread of tree. Mulch is applied 8 inches deep, later settles to ground level; it does not touch trunk. As tree grows, circle of mulch is enlarged, to keep it 6 inches beyond spread of branches.

Control of Mice

For every asset there comes a price to pay. In the case of mulch the price is mice. Mice love mulch. Where the soil beneath is light and sandy as ours is, they move right in.

Several years ago, on the property next door, an unkept orchard with all its uncut orchard grass was bulldozed. That orchard had been a haven for mice. Upon the arrival of the bulldozer, the mice came scurrying over to our mulch. We soon began to lose hollies. The pine mice fed on the roots and the field mice girdled the bark. In a state of alarm we sent for Ernest M. Mills of the Department of the Interior, who has charge of rodent control. We learned all about the control of mice from him. Today there is not much damage. Every time a hole appears in the ground or in the mulch, we insert a couple of Mo-Go peanuts obtained from O. E. Linck Co., Inc., Clifton, New Jersey. These peanuts not only attract the mice but also the moles. For safe measure, especially prepared beer cans are placed at strategic points. These contain oats poisoned with strychnine (obtainable from the United States Department of the Interior, 59 Temple Place, Boston 11, Massachusetts). By removing one end of the beer can and hammering a good dent in one side, the cans can be placed on the ground, opened end slightly down so that rain will not get in, and the few poisoned grains of oats will not fall out. At present the greatest damage the mice seem to be doing is to our reputation—we often forget to explain the beer cans.

BLACK PLASTIC MULCHES

A novel material to use as a mulch

E. M. Emmert

MULCHES of all types are valuable aids to growing plants. Recently black plastic has been found to have some special advantages as a mulch.

Practically no kinds of weeds are able to come through black plastic; some large perennial weeds will push it up a bit but they also ultimately die. Ordinary loose mulches have to be quite deep to stop weeds. Most of these mulches add organic matter to the soil, which the plastic does not, but it has been found that black plastic stops packing and leaching by rain so well that the advantages of organic matter are in part obtained without adding it. Plastic keeps the soil loose and in an aerated condition so that favorable micro-organisms thrive.

Plastic Holds Moisture

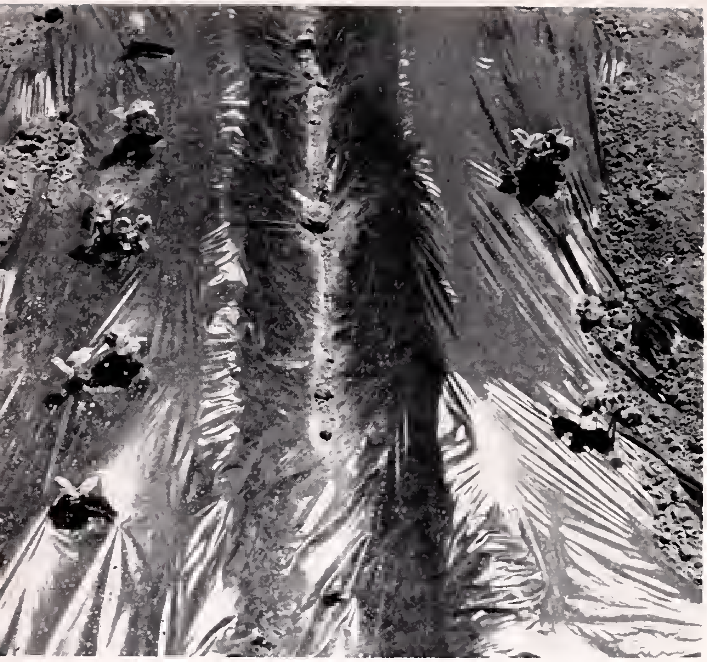
The plastic comes in strips and is tough enough to be walked on with flat-heeled shoes. To let water through, it is necessary to punch holes in it at intervals. If they are made correctly the plastic mulch will drain off excess water but retain enough for optimum growth. Because of the reduction in leaching, there is a surprising buildup of available plant food in loose soil covered by the plastic over winter. Plants and seeds can be planted without plowing in early spring before the ground can be worked. Where there is a gentle, even slope, soil will not pack down under the mulch for several years.

Plastic lasts at least three to four years, and since the soil stays loose beneath it, it is not necessary to take up the plastic and plow the soil each year. If soil with proper runoff is fertilized and plowed before covering with plastic, this will not have to be repeated for several years. Where water stands or backs up on soil, however, this will not be true.

Plastic mulch holds water better than a thin layer of loose mulch and is almost as effective as a deep layer of loose mulch. It can be laid level, with holes punched

Bakelite

Black plastic mulch comes in wide rolls.



Plastic mulch is anchored at edges with soil; plants emerge through slits. Holes at bottom of trench allow rain water to soak into soil.

Kentucky Extension Service

at depressions, but in these spots the soil will gradually become packed. A better system is to lay the plastic over furrows, with holes punched at the bottoms of the furrows. The holes are punched every foot or so, depending upon the slope (more holes are needed on steep slopes). With this system moisture stays in the mulched soil for weeks after exposed soil is bone dry. A little packing occurs in the bottoms of the furrows, but the raised soil on each side stays moist and loose and in optimum condition for plant growth.

Anchoring

Wind will cause trouble if plastic mulch is not well laid. Strips up to 4 feet wide will stay down in the strongest winds if they are well edged with soil and a little soil is placed in the middle of the strips every 3 to 4 feet. Wider strips will require more soil in the center.

Heating

In clear weather the soil temperature under black plastic remains from 10° to 15° F. higher overnight than on exposed soil. Even during cold cloudy weather the soil under the plastic remains warmer. This forces plants to make rapid growth.

A disadvantage is that this growth may be so early that unprotected tops of plants suffer frost damage. Clear plastic row covers should be used to protect tender plants.

Another danger attends the use of black plastic mulch. Sometimes in hot sunny weather the heat build-up in the soil may be excessive. This danger is small with large plants which shade the plastic, but freshly planted seeds or small plants may be injured.

Planting

Planting can be done directly through the plastic, or strips can be laid on each side of the rows to be planted. Large seeds can be readily jobbed through the plastic with a corn jobber. The planting tip of the jobber should be reduced in size and sharpened. Seeds can be planted this way as fast as can be done in bare soil.

Plants can be set through slits made in the plastic. The plastic pushes aside easily and springs back in place around the plants. It usually is best not to cut two slits at right angles, but simply to make one slit long enough to allow setting the plants.

Large seeds usually sprout fast and are above the plastic before small seeds get a start. If the slit is small, beans, vine crops, corn and such large-seeded plants get so far ahead of the few weeds that may start that practically no weeding is necessary. With small-seeded plants, weeds may come in the slits at the same time and be something of a problem.

For small seeds of close-set plants such as lettuce, the soil can be worked up in late August or September, making slight furrows or broad ridges to allow for drainage. The worked soil is covered with plastic and left until early spring. Before winter most of the weed seeds in the top inch of soil will germinate and die. In spring, before unmulched soil is anywhere near ready for working, the plastic can be removed, revealing the soil beneath ready for planting.

If soil below the top inch is brought to the surface by stirring, weed seeds in this soil will sprout. But if care is taken not to disturb the soil too much, few weeds will appear because they sprouted and died the previous fall. After the planted seeds are up in rows, the plastic can be put back between the rows.

Cost

In addition to its other advantages, black plastic mulch is economical because of its longevity. If used on a large scale the 1½-mil-thick grade costs only a little over half a cent per hundred square feet. Laid in rows so it covers about half of the soil, the cost comes to about $125 per acre. This is only $25 a year, assuming the material lasts for five years. The cost of laying it on large areas by machinery comes to only a few dollars an acre. Since much of the usual plowing and cultivating is eliminated, the savings on this will soon pay for the plastic.

Bakelite

Plants in garden at left, mulched with plastic, are free of weeds and more vigorous than those in unmulched garden at right.

PAPER PULP AS MULCH

How one nursery uses an unusual material as a mulch

James Fanning

FOR several years now, paper pulp has been demonstrating its value as a mulch in the Brookside Nurseries, Darien, Connecticut. This mulch not only saves labor by eliminating the need for summer cultivation, but it fits in with the Nurseries' conservation program by making use of scrap paper, sawdust and shavings, and encouraging the activity of earthworms.

Making the Pulp

The main drawback in the paper mulching operation is the necessity of using machinery in making the pulp. The machine used is an Agromat, which consists of a steel cylinder with a motor-driven impeller at the bottom. The impeller, rotating at a high speed, macerates the paper fed into it (with water) by means of a series of teeth spaced around the edge.

A typical loading for the 50-gallon Agromat used by Brookside will consist of 7 or 8 pounds of old newspaper, 11 or 12 pounds of sawdust or shavings, and enough water to fill the cylinder without slopping over (about 45 gallons).

Author courtesy

Paper pulp mulch in beds of delphinium.

No toxic effect from the chemicals supposedly occurring in newsprint has ever been detected. Highly finished papers, however, have generally been avoided, or used in such small proportions as to be insignificant.

Applying the Mulch

The "soup," as it comes out of the Agromat, is spread on the ground by being poured out of coal scuttles, which have been found, by trial and error, to have a lip that is ideally suited to this purpose. It goes on to a depth of about an inch (being fluid, it can't go much deeper than that) and dries out in two or three days, depending on the weather, to form a layer averaging a quarter of an inch in thickness.

The surface of the area to be mulched should be as smooth and free from lumps as it can be made, since irregularities will cause unevenness in the paper layer and result in cracks through which weeds can grow. Once dry, the paper mulch will take a considerable amount of walking on (no spike heels, of course) and should, if properly applied, stand up for an entire growing season.

Of course, where the mulch is used around small, tender-stemmed plants it should be kept from actual contact with them, and this can be done by inverting a flower pot over each plant before pouring the "soup." In ten minutes the pulp will have become firm enough to remove the pots.

The layer of paper does not form a tight contact with the soil, and in this space earthworms find an ideal place to work. They feed, apparently, on the tiny bits of wood that drop out of the bottom of the layer of paper, and make their castings between paper and soil, thus helping the soil to get its necessary supply of air.

Soil temperature under the paper mulch is consistently 10° F. below that of unprotected soil in summer, and the moisture at the surface of the ground is practically constant. Rain or water applied by overhead irrigation soaks immediately through the paper, which does not get soft again once the original fluid pulp has solidified.

Replacing the Mulch

Proof against wind and water erosion, the paper mulch lasts through the whole growing season and does not show any appreciable deterioration until the end of the succeeding winter, at which time it can be tilled into the soil or repaired by patching with fresh "soup." Plowed under, the paper provides the equivalent of ten tons of organic matter to the acre, and this in a relatively solid form that does not have the troublesome bulk of peat, sawdust or untreated shavings.

To form a clean edge for the mulching layer, boards are laid down at the edges of the area to be mulched. These also serve as convenient walkways for the one doing the pouring and they can be moved after the mulch has set for about ten minutes. Incidentally, the greater part of the water in the solution seeps down into the ground, supplying the equivalent of almost an inch of rainfall to the ground that is being covered.

To prevent cracking due to heat expansion in large areas, it is wise to allow expansion joints. These are formed by laying down lengths of ½- or ¾-inch pipe at 10-foot intervals; these are moved as necessary just as are the edging boards.

No nitrogen is absorbed from the soil by paper mulch because of the air space between paper and soil. The air in this space, combined with the earth-loosening activities of the earthworms, provides sufficient aeration for everything with the possible exception of azaleas, which are notoriously demanding in their need for air at the roots.

The question of color in the mulch remains unsolved. Some people have objected to the dirty white of the macerated paper, and several attempts have been made to add coloring matter, but thus far nothing has been found that will retain a color for more than a few days. However, after a few weeks' weathering, the paper mulch takes on the grayish tones of a wasp's nest, and no longer calls attention to itself.

MISCELLANEOUS MULCHES

EXPERIENCE WITH GRAVEL MULCH

During the summers of the years 1952 through 1955 the land I worked, in northern Ohio, was subjected to severe local drought conditions. Showers came frequently enough, but they were so light as to do almost no good. The lack of water was aggravated by unusually high summer temperatures.

In an attempt to alleviate these conditions to some extent, it was decided to try a gravel mulch—on the theory that it would not absorb the little rainfall that did come, and would help prevent evaporation of any moisture that did run through to the soil. Admittedly, such a mulch would not be practicable for cultivated crops. Its usefulness is limited to perennial crops only—strawberries, rhubarb, asparagus, fruit trees, grape vines and other small fruits.

In the spring of 1954 a truck-load of pea-sized gravel was delivered and spread by wheelbarrow and shovel in those places where it seemed likely to do the most good. Results have been variable, and it is a little early to give a complete evaluation. One objectionable feature of such a mulch is that under hot sunshine it subjects the plants to merciless heat, reflected from its whitish surface. This is troublesome on plants which do not grow sufficiently large to shade the mulch. My strawberries, for instance, are kept pinched back and not allowed to run, so the heating effect of the gravel is sometimes serious.

Rhubarb, on the other hand, did much better. Its large leaves shade the ground, and the gravel mulch seems to stimulate growth through a much longer period than is usual for this crop. Currants too have done well since the gravel mulch has been used, and young fruit trees are growing as well, and possibly a little better than would be expected without it.

From my rather short experience with gravel mulch, I have concluded that it has its place, limited though this may be.

E. H. Faulkner

ALUMINUM FOIL MULCH

Heavy duty grade aluminum foil can be used as a mulch. It completely smothers weeds, and is an excellent seal for soil moisture. The foil reflects large amounts of heat away from the soil during the day, keeping soil temperatures as much as 20°F. lower than those of unmulched soil. At night, on the other hand, it reflects back heat which would otherwise be radiated away from the soil, keeping the soil up to 8° warmer. This evenness of soil temperature promotes more uniform growth of plants.

The foil is applied in strips on either side of the planting rows, leaving a space about two inches wide for the plants. Or, an entire bed can be covered and plants set in holes poked in the foil. Before the foil is put down the soil is fertilized in the ordinary way. Afterwards, if necessary, liquid fertilizer can be poured along the row between the edges of the foil. Unlike organic mulches, aluminum foil does not change the nitrogen content of the soil.

CORNCOBS AS A MULCH FOR ROSES

In many parts of the Midwest corncobs, specially ground for use as a mulch, are obtainable commercially. Useful as a general mulch, these ground corncobs are especially fine as a mulch for roses.

About the end of May (in Iowa) is the time to apply the corncobs as a summer mulch. Two days before application the beds are watered thoroughly. When the soil is workable, the top inch is carefully stirred up. Then the mulch is applied to a depth of 2 to 3 inches over the bed, keeping it a little away from the bases of the plants.

Feeding through the mulch is easily acomplished by placing the fertilizer on top of the mulch, working it in very slightly, and then watering thoroughly. To forestall any nitrogen deficiency that might arise, one pound of nitrate of soda can be mixed with each bushel of corncobs. Wetting the mulch slightly before mixing will cause the nitrate to stick to the pieces of cob and not sift down onto the soil when the mulch is applied. If the mulch is used without first nitrating, the usual precautions to avoid nitrogen deficiency must be taken (see page 52).

After the first fall frost, the mulch may be removed, stored, and used again the following spring. Or it can be worked into the soil. Then the customary winter protection is given. Corncobs themselves have been successfully used as a winter protection in experiments at Iowa State College. Bin-like structures are constructed around the beds, filled with the ground cobs, and the whole covered with a waterproof cover. It is most important that the cobs be kept dry. If they get wet they lose their insulating quality and the plants are subject to winter kill.

A. A. Plagman

ASPHALT MULCH

At first thought, asphalt seems an unlikely candidate as a mulch, but for certain special situations it has proven its worth when so used.

A serious problem for farmers, highway engineers, contractors, etc. is to hold soil on new construction such as roadbanks and waterways in place until a cover of grass or other plants can be established. Mulches of straw and similar materials are often used, but it is often difficult to keep these in place as well. Asphalt offers a solution to the problem. Special asphalts (ordinary kinds have not been found satisfactory) are applied by spraying in a thin layer directly on the soil, or on top of a straw mulch. In the latter case, the asphalt replaces the twine and peg system commonly used to tie the straw down. When applied to soil, the asphalt forms a spongy film about a sixteenth of an inch thick. This film protects the soil from erosion by wind and rain, helps retain soil moisture, and increases soil temperature slightly.

Before applying the film, the soil is prepared and grass seed raked into it. After the planted soil is moistened by rain or sprinkling, the asphalt is sprayed on. The seedlings push their way through the film, or through the numerous cracks which soon develop in it. After about a year's time the asphalt film completely disintegrates, with no apparent bad effects on the plants. Experience has shown that from 0.2 to 0.3 of a gallon of asphalt per square yard is the best rate of application. If less is used the film disintegrates too soon; if more, the film is so thick that seedlings can not come through it.

For further information write to the Asphalt Institute, 1270 6th Avenue, New York, N. Y.

THE USE OF SAWDUST MULCH

Wesley P. Judkins

HOME gardeners are sometimes reluctant to apply sawdust around their plants because they believe certain injurious effects may occur. Experience so far has shown the advantages to far outweigh the disadvantages; this material may be used without hesitation in any area where it can be obtained readily.

Advantages of Sawdust Mulch

Like other good mulches, sawdust keeps the soil cool during the hot summer months, and helps conserve soil moisture; it also helps rain water move into the soil. Weeds are easier to control in a mulched garden. The yield of the crop is increased and the quality is improved. Vegetables and flowers may be harvested from such a garden immediately after a rainstorm without walking on muddy ground.

Several additional benefits accrue when sawdust is plowed or dug into the soil after it has served as a mulch. Heavy soils become lighter and easier to work, and light soils have a higher water-holding capacity. When the sawdust has decomposed into humus, it increases the nutrient holding ability of the soil. This may be of real importance to sandy soil.

Sawdust Is Not Toxic to Plants

There is no conclusive evidence to indicate that sawdust contains substances poisonous to plants. There are no known chemicals in either hardwood or softwood sawdust which would injure plants. The question is frequently asked: "Won't the resin in pine sawdust injure vegetables or other crops?" No such injury will occur. Since resin is a gummy material which will not readily dissolve in water, it is not absorbed by plant roots. Evidence that resin will not hurt plants is the fact that grafting wax, applied to protect tender plant tissues following the grafting operation, contains resin. Actually, pine sawdust contains only about two per cent resin. The amount added to the soil by a sawdust mulch could not possibly injure growing plants.

Tannins and terpenes which may occur in some types of sawdust do not injure plants. Soils to which large amounts of tannin and tannin-containing materials have been added have produced normal crops.

Sawdust Does Not Make the Soil Acid

Contrary to popular belief, sawdust does not make the soil acid. Numerous tests conducted by research workers in different parts of the country bear this out.

Most soils in the eastern United States gradually become more acid because of the leaching effect of rain water. The final effect of sawdust is to help maintain or increase slightly the alkaline reaction of the soil.

Sawdust May Cause Nitrogen Deficiency

A deficiency of nitrogen may develop if large amounts of organic material are mixed with soil. This deficiency develops because bacteria which decompose the organic matter tie up the soil nitrogen in an unavailable form. Therefore, addi-

Author courtesy

Plants grow vigorously and weeds are easy to control in garden mulched with sawdust.

tional nitrogen fertilizer may be needed when sawdust is mixed with the soil. Most mulched gardens which receive the usually recommended fertilizer treatment do not need extra nitrogen. If a deficiency of nitrogen occurs the leaves of plants become light green or yellow. Under such circumstances apply nitrate of soda or some other high nitrogen fertilizer; followed by rain or irrigation, the condition will quickly correct itself.

Kind and Amount of Sawdust To Be Used As Mulch

Hardwood or softwood sawdust may be used either fresh or weathered. Fresh sawdust will last longer than old sawdust when used as a mulch, and will make soils somewhat lighter or more retentive of moisture when plowed under. Old or rotted sawdust will become humus more rapidly and is less likely to cause nitrogen deficiency.

A 1-inch layer is sufficient to give satisfactory moisture conserving and soil cooling effects for shallow-rooted crops like vegetables, flowers and strawberries. A thicker covering will be of little additional benefit around such crops, and may add to the problem of nitrogen deficiency when the material is plowed into the soil.

A 2-inch layer of sawdust may be used around trees, shrubs, roses, or berry bushes where a permanent mulch is to be maintained. This depth will be more effective in controlling weeds and will not need to be renewed as often as a thinner covering.

Shavings and Wood Chips

Shavings and fine wood chips may be used as mulch in much the same way as sawdust. They should not be applied until after the young plants have become well established. When the vegetable or flower seedlings are several inches tall apply the shavings or chips to provide a 1-inch mulch.

Coarse wood chips are not recommended for a garden which is to be

Author courtesy

Sawdust is excellent mulch for everbearing strawberries grown in bed system shown here.

plowed each year. Apply this coarse material around shrubs, berry bushes or trees where a permanent mulch is to be maintained.

Sawdust Mulch for the Vegetable Garden

Good results will be secured by planting vegetable seeds and covering them with soil in the usual way. Then spread a band of sawdust about 4 inches wide and ¼-inch thick on top of the row. This mulch helps to reduce crusting of the soil and allows the young vegetable seedlings to emerge easily.

When the vegetables are about 2 inches high apply a full inch layer of sawdust over the entire area between the rows of vegetables. If weeds are more than 1 inch tall they should be killed by cultivating or hoeing before the mulch is added. If weeds are less than 1 inch tall the sawdust will smother them.

Some weeds will continue to come up through the mulch. Pull these out by hand or carefully cut them off with a sharp hoe. The weeds are very easy to pull when the ground is moist after a rain. Do not cultivate because this will mix the sawdust with the soil and destroy its value as a mulch. Also, every time the soil is stirred weed seeds come up near the surface where they will germinate. Therefore, every time a garden is cultivated in the usual way one crop of weeds is destroyed, but another is planted!

Sawdust mulch will not suppress the growth of quackgrass or Bermuda grass. In fact, weed grasses may be more difficult to control in a mulched garden than in a cultivated one. Crabgrass may become a problem in late summer unless the young plants are removed when they first appear.

Fertilizing the Mulched Garden

Fertilize the sawdust mulched garden in the same way as a cultivated garden, with complete fertilizer. Use about 30 pounds of a 5-10-5 fertilizer per 1,000 square feet of area or 75 pounds for a 50-x-50-foot garden. (One pint of fertilizer weighs about one pound.) Broadcast the fertilizer on the spaded or plowed land and rake (or harrow) it deeply into the top 2 or 3 inches of soil. If you prefer to apply fertilizer in the row, use 6 pounds per 100 feet if the rows are 2 feet apart. Apply proportionately less or more if rows are spaced closer or farther apart. If the soil has been tested and shows a low level of potassium, use 5-10-10 fertilizer.

As the garden grows during the summer, watch for any tendency of plants to become light green or yellowish in color. If such evidence of nitrogen deficiency appears, apply a side-dressing of fertilizer containing readily available nitrogen along the row. Do not cultivate to get the fertilizer into the soil. Rains will wash the beneficial nitrogen into the ground. Cultivation will destroy the mulching effect of the sawdust. Materials such as nitrate of soda, ammonium sulfate or ANL (ammonium nitrate limestone) may be used at the rate of about 2 pounds per 100 feet of row. Ammonium nitrate may be used at the rate of about 1 pound per 100 feet of row.

If a nitrogen fertilizer is not available, complete fertilizer may be used for side-dressing. Apply about 6 pounds of 5-10-5 along each 100 feet of row.

After sawdust has been used as a mulch in the garden, it can be plowed or dug into the ground to improve the workability of the soil. This improvement in soil texture usually will give increased yields of better quality vegetables. If the soil is medium to heavy in texture, plow in the fall or winter. Do not wait until spring because the sawdust mulch will prevent the soil from drying out and may cause an undesirable delay in plowing. This is not so important when plowing sandy soils; if the soil is sandy it may be plowed in early spring.

Sawdust Mulch for Flowers

Sawdust mulch can be used for annual or perennial flowers just as for vegetables. For most flowering plants, keep the mulch no deeper than 1 inch. A thick mulch may limit soil aeration and promote root and stem rot organisms. A 1-inch layer will encourage vigorous growth and abundant flower production over a long period of the summer. If the flowers are making poor growth, a side-dressing as suggested for vegetables may be helpful.

Standard Spring-Crop Strawberries

Sawdust may be used instead of straw as a mulch for standard spring-crop strawberries. A 1-inch layer is adequate to promote vigorous, fruitful growth. Apply this mulch late in the summer after the runners have become established or in the fall after one or two heavy frosts have occurred. With a full inch of sawdust, no additional mulch of straw will be needed to protect the plants from cold during the winter.

Everbearing Strawberries

Everbearing strawberries will produce large crops of fruit if grown in a hill system with sawdust mulch. In a home garden a planting of everbearing strawberries 40 feet long and 15 feet wide may produce 100 quarts or more of strawberries the first year.

A four-row bed system in which the plants are set 1 foot apart in rows 1 foot apart is recommended. Plant four such rows and then leave a 2-foot alley as a path to work on when picking the fruit or removing weeds, blossoms and runners.

The first crop of weeds will usually appear within 2 or 3 weeks after planting the strawberries. Control them by hoeing. The plants are too closely spaced to allow for cultivation. After this first hoeing operation, cover the entire area with a layer of sawdust 1 inch thick. Weeds which appear after the mulch is applied should be pulled by hand, preferably after a rain, when the ground is soft.

Shrubs and Berry Bushes

Most ornamental shrubs will grow more vigorously if a mulch of about 2 inches of sawdust is maintained on the soil under the branches over the rooting zone. This is especially true of evergreen shrubs, particularly azaleas and rhododendrons. Most shrubs have many small feeder roots near the surface of the soil. These are injured if the ground is cultivated and also may suffer in a dry unmulched soil. A mulch of sawdust, peat moss, peanut hulls or chopped straw is good for these plants.

Berry bushes such as blueberries, raspberries, blackberries and currants usually grow much more vigorously and are more fruitful if a mulch is placed on the soil around the plants. Use a 2-inch layer of sawdust or other organic mulch material. As this mulch decomposes into the soil, add more to maintain the desired depth. Maintain a sufficient layer of mulch to keep down weeds.

A mulch around grapevines may promote an undesirable succulent, vegetative type of growth on fertile soils where adequate amounts of rainfall occur. On the other hand, a mulch may be quite beneficial for grapes on sandy or gravelly soils where the water supply may be somewhat short during the growing season.

A SAWDUST MULCH FOR BLUEBERRIES AND STRAWBERRIES

E. P. Christopher

SAWDUST is a waste product in many areas and speculation on its value as a mulch or soil amendment has been widespread. To settle some of these matters, experiments were begun at the Rhode Island Agricultural Experiment Station in 1942. Our results, therefore, reflect long-time as well as short-time response. We used blueberries as the cultivated crop in most tests. Some data are available on the effects with strawberries and ornamentals.

Sawdust has been generally credited with acidifying the soil. In our tests, this generally accepted premise has not held true. Actually, soil reaction has been changed very little by the mulch, but always in the direction of greater alkalinity rather than acidity. We have worked with acid soils and it may be that soils already alkaline in reaction would become more acid.

A second question answered by our tests was that of the relative effects of hardwood and softwood sawdust. We found that hardwood sawdust broke down more rapidly than softwood, and both gave excellent results. Rather than give trouble because of high resin deposits, the softwood sawdust gave slightly better results.

On Blueberries

Sawdust on blueberries was applied to cultivated and reasonably weed-free soil to a depth of 4 inches; after settling, it was about half this depth. When used on strawberries, the initial application was half that for blueberries. Roots frequently developed in the sawdust itself, and those in the soil below it were much more fibrous than those developing in the cultivated soil.

Soil temperature effects were very definite. Soil warmed somewhat more slowly in the spring, but remained warm much longer in the fall. The variation in soil temperature from day to day was slight. Although we made no detaile studies as to optimum soil temperature for blueberry roots, the more even temperature under a mulch may be an important factor in influencing yield.

Yield

Yield is always an important consid eration. Over a period of many years sawdust-mulched plants have outyielde those under other treatments.

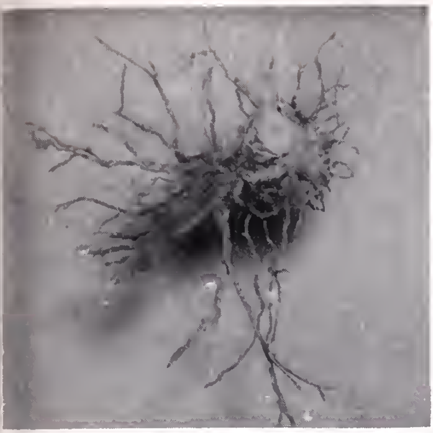
Typical Blueberry Yields
With and Without Mulch

	Yields in quarts per acre			
Treatment	1st yr.	2nd yr.	3rd yr.	Averag
Sawdust mulch	3528	3301	3144	3324
Straw mulch	1849	2294	2296	2146
Clean cultivation	1405	1646	2113	1721

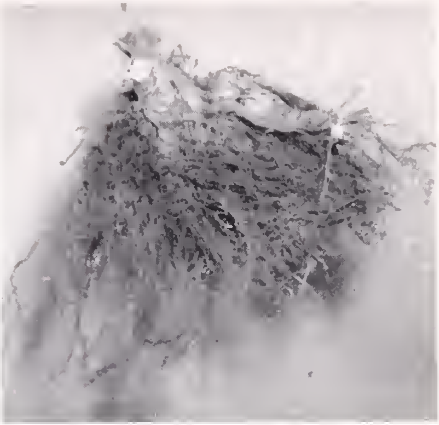
The berries were larger when mulc was used, but there appeared to be slight delay in ripening early in th season. Equal amounts of a complet fertilizer were used on all plants. Mulche caused no noticeable nitrogen starvatio on blueberries.

Weeds

Weed control is an expensive and tim consuming cultural operation. From ou experience, sawdust mulch is effective i



Root system of blueberry bush grown under clean cultivation.



Root system of blueberry bush grown under sawdust mulch has robust fibrous root system near surface of soil, where most nutrients are available.

controlling most weeds and greatly reduces the labor involved in the removal of others. Only very strong-growing weeds such as dock (*Rumex*) and persistent ones such as quackgrass gave any trouble. The first was uprooted with little difficulty and the stolons of the second were removed more completely by hand in the sawdust than was possible under clean culture. The stolons ran, for the most part, in the sawdust itself, and could be removed with reasonably clean hands and unbroken fingernails.

On Strawberries

With strawberries, a 2-inch sawdust mulch gave excellent weed control, clean berries, and somewhat increased yield. The labor of culture was greatly reduced. However, we did find it necessary to increase fertilizer applications by 50 per cent to prevent nitrogen starvation. The runner plants rooted well through 2 inches of sawdust, and winter survival was improved by the protection afforded the crowns. When strawberry beds are renewed frequently, the question of mulch disposal must be faced. Labor is involved in removal, and spading it into the soil may create nitrogen starvation problems. In our experience, the small amounts of sawdust that remained after weathering for two years could be plowed under without difficulties, provided nitrogen was added also.

Several ornamental shrubs grown under sawdust mulch responded well. Our experience has been more limited in this field, but sawdust proved our best treatment when used on *Pieris japonica, Rhododendron hybridum,* and *Rhododendron molle.* Peat moss was used in the same experiment and was nearly as satisfactory. Both were far superior to clean cultivation.

Strawberries in foreground under sawdust mulch are completely free of weeds.

Photos author courtesy

Courtesy Ohio Exp. Station

Straw mulch around trees in apple orchard.

MULCHES FOR FRUITS AND ORNAMENTALS

Freeman S. Howlett

THE effectiveness of various mulching materials as a means of conserving water has been under observation for many years at the Ohio Agricultural Experiment Station. In fact, such a study was initiated in 1900 in a young apple orchard which was successfully maintained under straw mulch until its removal over forty years later. Other experimental orchards were subsequently subjected to the same treatment and within the last few years research has turned its attention to the use of mulches in the culture of grapes and small fruits such as raspberries, as well as ornamentals.

The use of some sort of cover to reduce surface evaporation and water loss through transpiration from weeds and grasses is actually as old as the ancien Chinese, who made use of stones for this purpose. In fact, quite recently I observed a strawberry planting mulched with small pebbles. (See page 48). However, only within the last forty years has the use of straw or hay mulch been recommended, particularly in regard to its effect on the development of fruit bearing plants.

Straw Mulch on Apples

But the full benefit of the practic cannot be achieved without fulfilling certain requirements. In the first place, th mulch must be thick enough and replen

Straw mulch under apple tree covers ground under full spread of branches.

Winter mulch of straw around young fruit tree. In addition to leaving space between mulch and trunk, a wire guard is often used for rodent protection.

Toenjes photos

Red raspberries mulched with straw.

ished often enough to form a 4-to-8-inch layer of decomposed material. This layer permits the roots of the plant to spread out abundantly through the surface layers of the soil, growing upward in some instances into the mulch layer itself. When an apple orchard which had been mulched since 1916 was removed a few years ago, some of the roots in the decomposed mulch layer had grown to more than the thickness of a pencil, and many small roots emanated from them.

Too thin a layer not only results in an excessive loss of moisture but the undecomposed material induces nitrogen deficiency. While it is expected that a straw mulch might result in such a temporary deficiency, experience with apple trees indicates that after a year or two at the most, the annual application of a heavy mulch no longer results in nitrogen deficiency.

A leguminous mulch such as clover or alfalfa hay, which decomposes rapidly and must therefore be renewed more frequently than a straw mulch, will not require the addition of any soluble nitrogen fertilizer and will naturally produce a higher nitrogen content in the plant than a non-leguminous material. Generally speaking, however, the non-leguminous type of mulch is preferred for fruit trees because of its less rapid breakdown.

In the case of stone fruits such as the peach, plum or cherry, a hay or straw mulch serves as a useful means of conserving moisture; but with peach, nitrogen deficiency occurs more commonly than with apple. For pears grown in an area where fire blight is a serious hazard, mulches are not suggested. Here a non-leguminous sod culture supplemented with intermittent applications of a soluble nitrogen-carrying fertilizer is recommended.

An additional benefit of mulching is that it favors the availability of several major nutrients. Tests at the Ohio Experiment Station in an apple orchard

Unmulched vineyard is infested with weeds; vines are thin and not very productive.

Vineyard mulched with straw is weed-free; vines are strong and yield heavily.

McFarland

Straw mulch on foundation planting of ornamentals. In such a location other materials such as buckwheat hulls, sawdust, or peat moss are equally good as a mulch and look considerably neater.

Gantner

Mulching strawberries is a common practice. Here salt hay mulch keeps the fruit clean and helps prevent rot.

which had been mulched continuously with straw over a period of years showed that the potassium supply in the soil was very high. In fact, the potassium content in a mulched soil as compared with one under cultivation was shown to be several times greater. Furthermore, it was found that this mineral, contrary to expectations, had not become fixed in the upper surface layers but had penetrated rather uniformly to a depth of 20 to 24 inches. The fact that the predicted fixing of potassium in the upper soil layers did not occur must be attributed at least partially to the favorable moisture supply continuously available at the lower surface of the mulch.

In addition to the major elements such as nitrogen, phosphorus and potassium, trace elements are also supplied by mulches. Frequently the fruit grower has no practical means of determining an approaching deficiency of these elements. In fact, our increasingly large fruit crops tend to absorb greater quantities of boron, manganese and iron. Straw and hay mulching material grown on soil where such elements are known to be abundant will serve to alleviate or prevent orchard deficiencies of this sort.

Small Fruits

While growers have recognized the mulching process to be beneficial for tree fruits and for strawberries, they have shown a tendency to avoid mulching in favor of cultivation in the case of other small fruits. Results of studies conducted at the Ohio Station and elsewhere with grapes, red raspberries and blueberries, comparing mulching and a program of cultivation with cover crops, definitely show the mulching system to be better.

Grape vines mulched with an 8-to-10-inch layer of straw outyielded the cultivated vines by 25 per cent, and the vine foliage contained more nitrogen, phosphorus and potassium, although less magnesium and calcium, than the cultivated vines. Red raspberries mulched with wheat straw showed a 10 per cent increase over cultivated plants as well as an increase in size of berry. Blueberries mulched with peat moss or sawdust showed an increase over the cultivated berries of 80 per cent in the first case and 152 per cent in the latter. Obviously, under different types of mulches the nitrogen supply must be carefully checked. (See pages 50 and 52.)

Ornamentals

The use of mulches in the cultivation of ornamentals is also increasing. A wide variety of materials is found to be practicable, as brought out in accompanying articles. I might briefly mention peat moss, sawdust, peanut hulls and especially ground corncobs. The latter have been found to be particularly effective for both garden and greenhouse roses. The cobs, ground rather coarsely (3/8 to 3/4 of an inch), do not compact as much as some kinds of organic mulch and also, due perhaps to their chemical composition, they tend to promote soil aggregation. One or two inches of mulch keeps the soil cooler, much like insulation in house walls, thus encouraging satisfactory root development.

However, with ornamentals as with fruit plants, precautionary measures must be taken to prevent nitrogen deficiency, especially with such materials as corncobs, straw or sawdust. All these materials encourage bacterial growth, and must be supplemented with nitrogen. Otherwise nitrogen deficiency may result in the stunting of the plant.

Mulching may be considered to be a modern and more efficient substitute for cultivation in that it controls weeds, conserves moisture, and improves the physical condition of the soil. In addition it supplies certain mineral and trace elements. In fact, in certain fruit crops mulching may even prove superior to irrigation because a more moderate water supply is made available. Obviously, under severe drought conditions applications of water may be necessary. Though mulching materials may be difficult to obtain in some localities, an effective mulching program will repay both the effort and expense involved.

METHODS AND MATERIALS FOR MULCHING RHODODENDRONS

Warren Baldsiefen

A decade and a half of experience and careful consideration have taught me that for the most beneficial all-around mulch is the needles of conifers. Both plantations and those indigenous to almost any region provide a variety of species from which to choose. Because of their abundance in the East red and eastern white pines are utilized the most, although jack, pitch, Virginia, Austrian, and Scotch pines have been used with equal success. Offhand, I can think of no region where rhododendrons are grown that conifers will not also thrive, and any reasonable effort expended in gathering needles will be well worth the time.

Pine Needle Mulch

The needles of red pine (*Pinus resinosa*), being coarser and somewhat larger, tend to resist decomposition longer. I use these on larger plants. The soft delicate texture of white pine (*Pinus strobus*) needles makes them extremely well suited for mulching either small alpines or one- or two-year-old large-leaved sorts where the mulch, in order to be most effective, must be worked closely around the stems. I have seen pebbles used as a mulch on alpines but did not notice any results superior to those mulched with pine needles. Moreover, in commercial growing where every few years transplanting

Pine needle mulch helps maintain acid soil conditions around rhododendrons.

Buhle

Oak leaf mulch around rhododendrons, held in place by low wire fence.

is necessary, the ease and convenience with which pine needles are removed makes them, in my opinion, far superior to pebbles. The leaves of spruce and tamarack, being short and slender, are exceptionally good mulches for dwarf or very young plants. These, or any other small needles, are applied by being gently broadcast over the plants to the desired thickness. Any needles which adhere to the plants may easily be removed by gently brushing over the rows with a light small stick.

Beneath plants three years or older, which are lined out either in the field in full sun or under lath shade, depending on their parentage, I spread a mulch of red pine needles approximately 3 to 4 inches deep over the entire area. After settling, which takes several months, the depth is reduced to about 2 inches. If undisturbed such a mulch will serve the plants three to four years. If the plants are removed for any reason, the mulch, if scraped away before digging, can be replaced and reused. Neat in appearance, a needle mulch settles to an even, tidy cover that never can mat down or become sodden. The criss-crossing, interwoven needles allow good aeration, yet never under any conditions become scattered by gusts of wind. No unsightly weights in the form of sticks or lengths of board that might entangle spray equipment or otherwise interfere with day to day working around the plants are necessary to hold the mulch in place. Both the insulating and moisture-holding capacities are superb.

Young plants out of pots or out of the rooting frames and older stock, up to the time they are lined in the field or lath house, are mulched with spruce, tamarack or white pine, or shredded needles of the coarser pines. This mulch need not be 3 to 4 inches in depth, since the smaller needles apparently insulate equally well when spread to only half that thickness. At the height of the summer, during the hottest days of the season, when the temperature soared to over one hundred, the temperature 2 to 3 inches under such a mulch hovered in the mid-seventies.

Leaf Mulches

Oak leaves are a good mulch, and for that matter I know of no deciduous leaves that are not satisfactory. Shredded, they are less apt to be caught by the wind and will cling better to the ground; but as this entails considerable extra work, it is not usually practiced commercially for plants lined in the fields. It is done occasionally for small plants. Large leaves in such a situation almost seem to smother little plants. However, the old belief that the use of maple and elm leaves invites disaster because of their alkaline residue upon decomposition has not, in my experience, proven true. I have seen many rhododendrons mulched with such a covering without the plants suffering any ill effects.

The rapidity with which leaves decompose has a large influence on the acidity or alkalinity of their residue. The more rapid the rate, the more alkaline. And so it might be that even oak leaves, rapidly decayed, would tend to be neutral. The chief objection to a leaf mulch is their blowing about, accumulating deeply in some areas and leaving other sections bare. Especially around plants where the mulching is left to nature's hand, the thick soggy layers matted together form an almost impervious layer, defeating one of the prime requisites of a mulch: to be light, airy and allow free air circulation.

Peat Moss

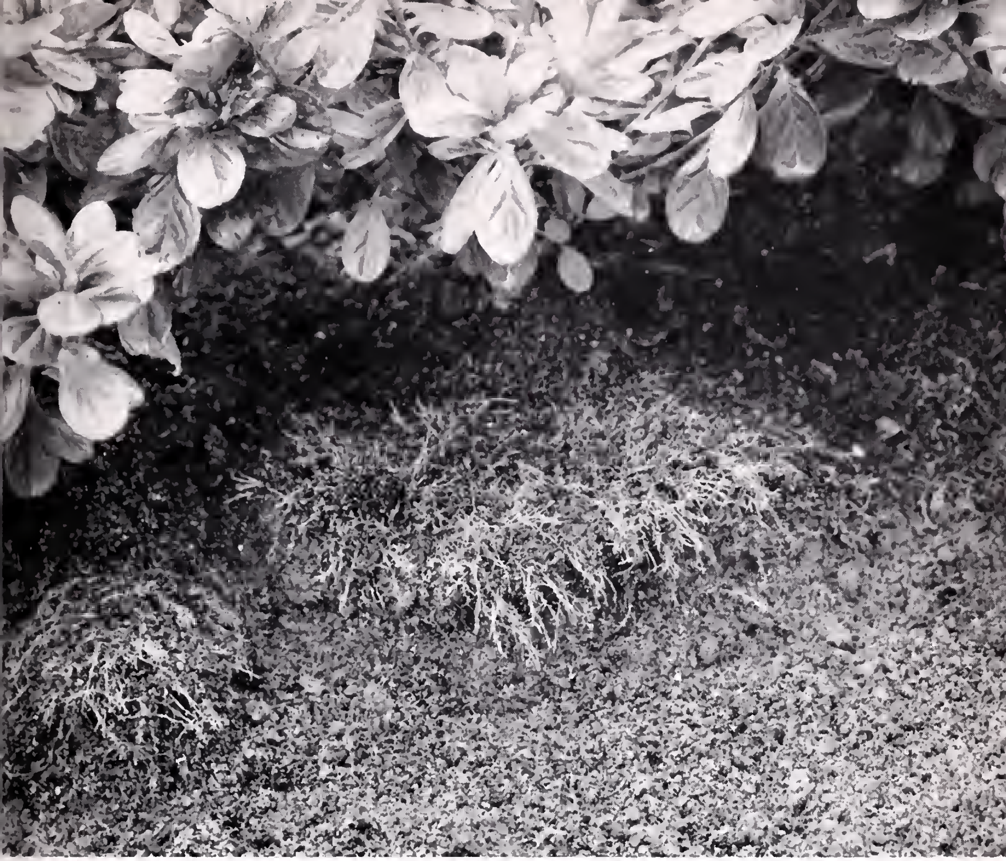
Peat moss can be used for mulching for lack of a more suitable material. It is not one of the better mulches for rhododendrons. I have never seen it used commercially on any scale. Around the home it gives the beds a somewhat manicured appearance, perhaps too much so for rhododendrons. A likely victim of high winds, it must be replaced every year, or nearly every year. An outstanding fault and major drawback of a peat mulch is that once dry it sheds water like a duck. Therefore, to serve the purpose of a mulch, it must be kept moist with periodic sprinklings during the hot dry summer, perhaps once a week. The thicker the layer of peat, the less apt it is to dry. I have never observed fine rootlets grow to the surface of the mulch and be destroyed, though in theory it seems possible. From past experience in plunging potted rhododendrons into peat, I can recall numerous instances when the roots reached into this medium just below the surface, without any apparent harm to the plants. If some roots did rest on or near the top of the peat for a brief time before being killed, it was not discernible.

Sawdust

The words "sawdust mulch" are becoming about as controversial as the word "hardiness." There always seems to be someone who will dispute any statement that is made. In the last few years I have become thoroughly convinced that some sorts of sawdust have their useful place in certain phases of rhododendron culture. As a permanent mulch sawdust can be used, and with success. However, the material must be coarse enough to allow ample air and water circulation. Sawdust from a craftsman's shop usually is too fine and will pack and cake on drying. Sawdust from the mill where the rough logs are cut is coarser and more satisfactory.

I have seen plants thriving under a cooling cover of sawdust. It is a first-rate insulator, and temperature readings under layers of sawdust of the same depth as those other valuable mulch materials left no doubt but that those plants under sawdust had roots cooler by a few degrees.

Of the many hardwoods and softwoods native to the East, the only sawdust that



Seabrook Farms, Taubert

Heavy fibrous roots of azaleas mulched with sawdust.

has been reported as having a harmful effect is that of white pine (*Pinus strobus*).*

Nitrogen Deficiency

We know that sawdust (mainly cellulose and lignin) in its decomposition to humus will borrow nitrogen from the soil. This is brought about by the cellulose bacteria which demand for their existence more nitrogen than can be supplied by the wood. They therefore take nitrogen from the soil, nitrogen that would normally be used in the growth of plants. And this nitrogen is then later returned to the soil upon the death of the bacteria. In this temporary process of decay we must supply small amounts of nitrogen to the plants (inorganic being more readily available) to supplement that which has been borrowed from the soil. This amount has been established at 2 pounds per 100 square feet of surface for every inch depth of sawdust mulch applied. It may vary with the kind of sawdust but probably so slightly that the above rule will still apply. After the mulch has been in place a year, the annual spring feeding should cover the needs of the plants. If not, a trace of additional inorganic nitrogen can be added.

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*Scientists working with mulches at various experiment stations were asked about the possibility of plant poisoning by white pine sawdust and reported that they have not heard of it. However, until careful experiment has settled the question one way or the other, cautious gardeners may wish to play safe by avoiding pure, fresh white pine sawdust.—Ed.

Sawdust in Nurseries

The commercial use of sawdust, which resulted from accessibility and low cost and the ease of application, has, from my observations of its use from Oregon to New Jersey, resulted in many failures. In commercial growing a crop is removed from an area every few years either to be re-spaced or to be sold. And it is here that the trouble begins, for when these plants are lifted some mulch, left from digging, falls into the hole and the sawdust becomes an ingredient of the soil. Perhaps meticulous care might prevent this but I have never seen it so, and in every instance where plants were removed, sawdust, only partially decomposed, was mixed with the soil and the next plants placed there had to compete with it for nitrogen. Many sorts of woods (as sawdust) take a dozen years or more to break down and in this time several crops of rhododendrons can be taken from a given area. Each time more sawdust enters the soil and each time the supplemental nitrogen feeding becomes more grotesquely complicated. I have seen it become so hopelesly disastrous that, as a consequence, fields were left fallow for years.

The theory that periodic feeding will eliminate this fault is weak. If in the late summer, with leaves showing deficiency symptoms, we could ascertain with any degree of accuracy precisely how much nitrogen is needed, a safe application might be made. However this is impossible, for we have sawdust both as a mulch and as a soil amendment in various stages of decay, possibly complicated by several different kinds of wood. To try to supply the proper amount of nitrogen without overstimulating the plant at such a critical time just before cold weather is, in my opinion, next to impossible. In sections which are subject to extremes of climate in both summer and winter, any measures which alter the plant's natural metabolism, even slightly, can be fatal at these sustained periods of high or low temperatures. I have also seen the quick death of plants from the effect of sawdust in the soil. In other instances, growth was retarded for a year before returning to normal.

Wood Chips

Wood chips make an excellent permanent mulch. Today huge shredders which grind up limbs pruned in line clearance and street shade-tree maintenance are a source of large quantities of good mulch. Chips the size of a quarter and smaller and twigs and pieces up to 4 to 6 inches long, mixed with chopped leaves, provide a material that will prove a valuable acquisition to rhododendron culture. Being coarse and of random sizes, there is always sufficient air space after they settle. From my observation over a period of several years, there is absolutely no nitrogen deficiency problem as there is with sawdust. This may be due to the fact that chips by comparison, being so much larger than sawdust, have infinitely less surface area, and in their decomposition engage relatively fewer microorganisms. This is just an assumption. Chips make a neat covering, by no means unsightly, and seem to "belong" with rhododendrons. I think they have a great future as a mulch. I have seen them used commercially without any problems; and where they were plowed into the field after a few years, they had no noxious effect on the next crop.

There are many other satisfactory materials used for mulching, and those herein described are only the most popular kinds. As the years go by we will include in the present list of mulches new and possibly better substances, perhaps replacing what we now consider to be the best.

METHODS AND MATERIALS FOR MULCHING

CAMELLIAS

John L. Koehne

MULCHING camellias in the Washington, D. C., area—long considered the practical northern limit for growing camellias outdoors—and further north is probably one of the most important and necessary requirements if they are to grow and bloom successfully. This area is subject to considerable variations in temperature and precipitation both annually and from month to month during any given year. Through the year-round use of a mulch, however, the dangerous effects of these extremes can be reduced to the point that hardy camellias will prosper and flourish most rewardingly.

Any number of different types of materials are used for mulching. The best in our experience are pine needles, buckwheat hulls or peat moss. In selecting the material to be used as a mulch it is important that it be one which will not pack down, thus preventing water and air from being readily available to the camellia's surface roots.

Pine needles have proved to be particularly good as a mulch in this area as

Peanut hulls make a satisfactory mulch around camellias and are generally available where camellias are grown.

McFarland

they are readily available to most gardeners and not too expensive if a free supply cannot be found. They do not pack down and further, as they gradually decompose, they help provide natural acidity for the plant. The Norfolk Municipal Gardens, for example, which has one of the finest collections of camellias and azaleas, grows its plants in a natural site under pine trees and does not find it necessary to fertilize them or give any other special attention to soil problems. When using pine needles, they should be spread from the plant to well beyond the ends of its branches and to a depth of 3 to 4 inches. As they decompose and settle, care should be taken to insure that the proper depth is maintained. This requires the addition of new pine needles about every nine months.

Buckwheat hulls spread at a depth of 3 inches have also proved to be a good mulch. They do not pack down, help retain soil moisture, and provide a good insulating cover for the camellia's roots against extremes of heat and cold. They have no food value whatsoever since they are extremely slow to decompose. They may have a tendency to blow or scatter in high winds when initially applied, but this problem seems to disappear after a few months. Buckwheat hulls are comparatively cheap unless one is not close to a source of supply and has to pay freight or shipping charges.

Peat moss, long recommended as a mulch, is perfectly satisfactory if one exercises due care to prevent its drying out. A depth of 2 to 3 inches is adequate. There is one danger if one is away from the garden for any length of time and no care is available. *Once the peat moss has dried out it resists rainfall and prevents moisture from reaching the camellia's roots;* in fact, when surface moisture is lacking, peat moss has a tendency to draw moisture from the soil beneath it, which is bad for the plants.

Other materials that have been used for camellia mulches, but with less success because of specific drawbacks connected with each material, include sawdust, oak leaves, and hay or straw. Also, as pointed out on page 19, mulches may add to the difficulty of controlling flower blight.

Frese

A few pine needles atop a peanut hull mulch generally improve its appearance.

Ground corncobs are a splendid mulch for roses and other plants. They are becoming increasingly available in corn-growing regions.

METHODS AND MATERIALS FOR MULCHING

ROSES IN THE MIDDLE WEST

Griffith J. Buck

USING mulches is essential in growing roses in the Middle West, for they conserve soil moisture, modify summer and winter soil temperatures, control weeds and thus eliminate the need for frequent cultivation, and aid in pest control (see page 17). But it is chiefly their role in conserving soil moisture and modifying soil temperature that makes mulches an integral part of rose culture. The problems posed by water and temperature must be solved if the rose is to be a satisfactory garden plant in the Midwest.

Mulches Reduce Need for Cultivation

Roses use large amounts of water, and too often, in recent years, dwindling water supplies and deficient rainfall have forced gardeners to rely on mulches to conserve the moisture available. But to say merely that mulches aid in conserving

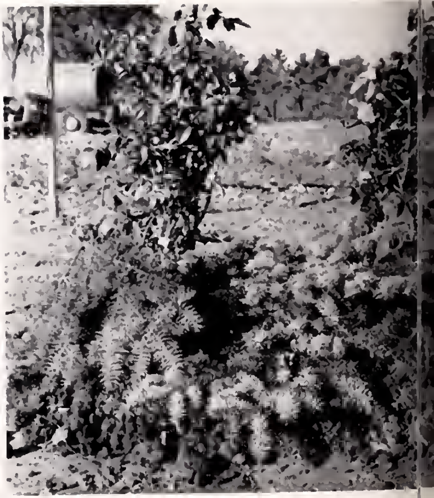
First step in winter protection of roses
cold climates is to tie the canes in a loo
⟵ bundle in late autumn.

Next, tied canes are mounded with earth at the base. ⟶

Straw mulch is placed over mounded ear
⟵

Photos author court

Spruce boughs are an excellent substitute for a straw mulch. ⟶



soil moisture is not enough; it is more complex than that.

Mulches aid the soil in taking up water. Cultivation eventually reduces the particle size of the soil to microscopic fineness and soils in this condition do not absorb water readily, rather they shed it, much as a duck's back sheds water. The individual droplets run together and then run off instead of soaking into the ground. Mulching eliminates the necessity for frequent cultivation, and thus minimizes soil texture destruction.

Moreover, mulches aid in the absorption of moisture by providing a material which retains water until it can be absorbed by the soil; contrasted with this is the bare soil, which is puddled by falling water and soon crusts, and thus becomes less able to absorb water.

Check Evaporation

In addition to increasing the soil's capacity to absorb water, mulches inhibit the loss of water from the soil by evaporation. Water falling on a soil that is not mulched will evaporate until a surface layer of dry soil is formed that is thick enough to prevent dry air from coming in contact with moist soil at greater depths. Then, too, the puddling of soil during a heavy rain causes deep cracks to form, which expose more soil to the air, and thus increase the loss of water by evaporation. Mulches provide a protective blanket as well as shield the soil from the sweep of drying winds. Yet air will permeate the mulch to maintain adequate aeration of the soil below.

Aid in Adding Moisture to Soil

Mulches also tend to *add* moisture to the soil. They interpose an insulating barrier between the soil and the warm air, creating a difference in temperature between the upper surface of the mulch and the soil. This temperature difference s sufficient to condense moisture from he air. Granted, the quantity of water added in this way is not large; nevertheess it can be the determining factor in a plant's survival during a dry season.

Mulches Keep Soil Cool

Rose roots, as well as those of many other plants, grow most efficiently in moist, well aerated, cool soils. Soil temperatures within a range of 60° to 70° F. are most conducive to good root activity. However, during the average summer, soil temperatures frequently exceed this range, often for long periods, with the result that root activity slackens and plant growth and bloom decrease. Frequently very high soil temperatures and subsequent inhibition of root activity force the plant into semi-dormancy.

Mulching cannot convert high temperatures to low ones, but can, by insulating the soil from hot summer air, modify soil temperatures so as to eliminate the extremes and provide more constant soil temperatures.

Reduce Soil Temperature Changes

In maintaining more constant soil temperatures during the winter mulches are even more necessary to rose growers. In areas where an all-winter snow cover can be expected, the snow itself acts as an insulating blanket, eliminating the need for a mulch. But in the Midwest winters are usually open and the soil is exposed for long periods. Under these conditions the insulating effect of a mulch becomes beneficial.

In Iowa it has been demonstrated that soil temperatures under a mulch drop gradually and remain constant at freezing until late March, when they rise gradually. Maintaining this constant temperature eliminates much of the root and stem damage attributed to alternate thawing and freezing of the ground.

Gardeners should select suitable winter mulching materials with care. The ideal material is porous, remains dry and does not pack down around the plants. In the Middle West threshed soybean straw fills these requirements and is usually available at a nominal cost. Other materials such as marsh hay, excelsior and shredded corn stover (stalks) are equally valuable in areas where they can be obtained cheaply.

METHODS AND MATERIALS FOR MULCHING

DAHLIAS

Lynn B. Dudley

MANY materials can be used for mulching dahlias; we use salt marsh hay because it is easily available and quite cheap, and we have found by experience that it is excellent for the purpose. The salt hay is applied in the middle of July to a depth of about 4 inches. By this time the garden has usually been completely cultivated twice; after the mulch is put on it is not cultivated again.

The moisture-saving action of a good mulch is particularly important for dahlias. Under dry conditions they grow very slowly, become woody, and may never bloom. During a prolonged drouth it is almost impossible to water sufficiently with a hose to keep them going. But with a mulch to conserve what water can be applied, many plants will survive which otherwise might be lost.

Another great benefit of mulches to dahlias is that they keep the tuberous roots cooler during hot weather. During hot, dry spells these roots grow poorly and may be damaged by high soil temperatures. Mulches keep the soil cool, and the roots go right on growing. Other bulbous- or tuberous-rooted plants such as gladiolus, begonias and potatoes are benefited in the same way.

For best results the mulch should be dry. Fermentation in green mulches such as fresh grass cuttings may generate heat which can injure the fine feeder roots near the surface. If such mulches are used, care must be taken not to place them too close to the plants.

Author courtesy

Summer mulch of wheat straw helps hold moisture and discourages growth of weeds in author's dahlia garden.

METHODS AND MATERIALS FOR MULCHING CHRYSANTHEMUMS

Cornelius Ackerson

CHRYSANTHEMUMS are shallow-rooted plants. The fibrous roots develop from stolons which may extend several feet out from the plant but the mass of roots and stolons does not penetrate more than a few inches below the surface of the soil. Thus, it is important that an adequate supply of moisture be available in the surface soil to insure good growing conditions. Also, it is difficult to control weeds by cultivation, for even the most careful use of a hoe may result in the destruction of some roots. If the plants are set deeper in the ground in an attempt to overcome these problems the original roots die, and the survival of the plants depends upon their ability to produce new roots nearer the surface. A mulch is the ideal solution.

A mulch may consist of any organic substance which will not be injurious to plant growth. No one material can be considered as the ideal mulch, for each grower must balance the cost of the material used against the advantages obtained. Local conditions often dictate the type of mulch to use. Tobacco stems are available in our southern states at a reasonable cost, but transportation often makes the cost prohibitive in other areas. This is considered an excellent material, for, in addition to its mulching advantages, it also discourages insect invasions. Similarly in other areas, by-products, such as buckwheat hulls, may be obtained at a moderate cost. Peat moss is perhaps the best mulch for chrysanthemums from all standpoints except that of cost.

Chrysanthemums grow best in a loose friable soil, rich in humus. The breakdown of organic mulches helps produce these conditions. If nitrogen deficiencies arise as a result of the activity of microorganisms in some mulches (see pages 50 and 65) they can be overcome by foliage feeding or by use of a high nitrogen fertilizer.

Some mulches, such as oak leaves and pine needles, may increase the acidity of the soil. Chrysanthemums prefer a very slightly acid soil, about pH 6.5. If the mulch used makes the soil more acid than this, ground limestone should be applied, preferably in the fall.

In my own chrysanthemum garden leaves to a depth of several inches are used as the basic mulch, with peat moss added to provide a neat appearance. I gather the leaves in the fall and store them in an open crib over winter. Several weeks after the chrysanthemum plants are set out in the spring I place the leaves, which by this time have packed into wet sheets, around the plants. An inch layer of peat moss then adds an air of neatness and helps smother the crabgrass which germinates in the leaves.

I have used both bulk fertilizer, scattered over the top of the mulch, and liquid fertilizer, as a foliage spray, with no noticeable difference in plant growth. The mulch acts as a feeding regulator when dry fertilizer is used, for the chemical solutions filter through the mulch in a fairly uniform manner. Since the surface of the soil is always moist under a mulch in normal seasons, the fertilizer in solution is absorbed gradually by the chrysanthemum root system. When drought conditions occur, a mulched mum garden may go unwatered for several weeks without danger. When water is applied, the bed should be well soaked.

Chrysanthemum hobbyists who are not affiliated with the American Chrysanthemum Society may apply for membership to Miss Dorothy P. Tuthill, 345 Milton Road, Rye, New York. The yearly dues of $3.00 include a subscription to the Society's bulletin.

GLADIOLUS

L. G. Klein

THE gladiolus grows well under a mulch and because of the many advantages of mulching, discussed in other articles in this handbook, many growers are now using this system of culture.

Materials

Many organic materials are suitable as mulches for gladiolus. Clover or alfalfa hay, bean straw, pea vines, strawy manure and spent mushroom compost are among the best, as they contain sufficient nitrogen to make up for the deficiency caused by the activity of microorganisms (see page 50). Other materials such as cereal grain straw, sawdust and wood shavings are quite satisfactory provided that nitrogen fertilizers are added Nitrate of soda applied at the rate of 7½ pounds for each 100 pounds of mulch

Gladiolus plants mulched with 5 inches of straw after leaves are up.

Gilman photo

Sawdust mulch can be applied to gladiolus at planting time instead of later. Corms are covered with soil as usual, then 4 inches of sawdust is spread over the rows.

should be satisfactory. Nitrate of soda contains 16 per cent nitrogen. If another fertilizer is used, it should be applied in amounts that will give the same amount of nitrogen as the recommended rates of nitrate of soda will.

Time to Apply Mulch

No matter what mulch is used, the best time to apply it to plantings of blooming-size corms is after the plants have reached a height of about 10 to 12 inches. If applied before this, early growth may be retarded because the soil is kept cooler under the mulch. Moisture conditions are usually satisfactory until this time, so there is no need for earlier mulching.

Amounts of Mulch

With strawy materials, 6 to 8 inches of mulch is needed to provide good weed control. This will settle to a depth of about 2 to 3 inches, and gives good footing for traffic in the gladiolus garden. Sawdust or wood shavings should be applied to a depth of only 2 or 3 inches. Although I had used mulches in my garden for many years, a mixture of sawdust and wood shavings was tried for the first time in 1949. It has been used every year since. This mulch is much easier to apply than many others, and no nitrogen shortage has ever developed.

Bulblet plantings and gladiolus seed beds also benefit from the sawdust mulch. On these it is better to apply the mulch before the young plants appear above the ground. If it is put on after the plants have emerged, many of them will be bent over by the application and may not recover. For bulblet plantings a mulch of $1\frac{1}{2}$ inches is adequate; for seed beds $\frac{3}{4}$ to 1 inch of fine sawdust, sifted on, is enough.

Gilman

Shoots emerge easily through sawdust mulch, and sawdust settles to give neat, weedless walk between rows.

Clean Cultivation

Large growers may find it necessary to follow a system of clean cultivation. We are not suggesting that gladiolus cannot be grown successfully under this system, but we are saying that it is possible to cultivate too much. There is an old theory that cultivation conserves moisture and it is not uncommon for growers of cultivated crops to increase the frequency of cultivation during a dry period. This practice is now considered to be most wasteful of soil moisture. Cultivation also hastens the decomposition of organic matter and further reduces the moisture-holding capacity of the soil.

Growers who use clean cultivation should practice a system of "minimum cultivation" sufficient only to keep weeds under control and to prevent the development of too thick a crust on heavy soils. A good system is to cultivate lightly the first day or two after a heavy rain. This will prevent the formation of a surface crust with a minimum of effort and moisture loss, as any soil worked under will still contain almost as much moisture as that which is brought to the surface. When clean cultivation must be practiced, organic matter should be added liberally to the soil to maintain tilth and fertility.

If suitable mulching material is available at low cost, even large commercial growers would be well advised to consider mulching. The high labor costs of cultivating and hand weeding would go far toward purchasing and applying the mulch. Better quality flowers would be produced and the incorporation of the mulch into the soil at the end of the season would contribute materially toward maintaining an adequate supply of organic matter in the soil.

METHODS AND MATERIALS FOR MULCHING

LAWNS

J. R. Watson, Jr.

OF THE many mulching practices that are rapidly coming into use, lawn mulching is probably the least well understood by the average homeowner. In a sense, grass clippings left on the lawn form a mulch, but these have their distinct limitations, as will be pointed out below. The only true lawn mulches are those added as top-dressings. Soil put on an established lawn is called top-dressing. Although not a true mulch, it does perform many of the functions of a mulch.

Top-dressing

As to the several kinds of organic matter that make good lawn mulches: these include compost, manure, leafmold, various types of peat. All except the last named should be well-rotted before application to the lawn. As a general rule, top-dressing should be prepared by mixing a good garden loam with equal parts of organic matter and coarse sand. After thorough mixing, the material should be passed through a quarter-inch screen before being applied to the lawn area.

On established lawns one of the major uses of top-dressing is to fill low areas and level the lawn. Good weed-free top-dressing is also a good cover for seed, where thin or bare spots in an established lawn are being re-seeded. And in the southern states, top-dressing is desirable as a cover for the winter grasses which are seeded into warm-season grasses each fall.

Introducing weed seed contained in top-dressing materials is one of the major problems associated with this practice. Manure, unless sterilized or treated with weed-killing materials such as calcium cyanamid, is one of the major offenders in this respect.

Top-dressings may be applied to established lawns at any time during periods of active growth in spring and fall for cool-season grasses such as bent, Kentucky bluegrass and fescue; and in spring, summer and early fall for warm-season grasses such as Bermuda, zoysia and St. Augustine. Being dark and somewhat amorphous, a good top-dressing will absorb heat and insulate the soil. When applied in late winter or early spring, they will often hasten the melting of snow and ice on the lawn, as well as tend to stimulate earlier growth. Because of this ability to absorb heat, a top-dressing should never be applied to lawns of cool-season grasses, especially bentgrass, during the summer months.

One-half to 1 cubic yard is adequate to top-dress 1,000 square feet of lawn. This is equivalent roughly to 2 or 3 bushels per 100 square feet. Obviously, such a small amount of material will have little influence on the over-all physical properties of the soil under the lawn; yet, it may be enough to create layers with sufficiently different physical properties to interrupt proper water movement which may result in poor turfgrass growth. If such a result seems to obtain under certain conditions, the top-dressing may be worked into the soil beneath the turf surface with a soil aerator, as shown in the accompanying picture. This incorporation of mulch into the soil differs from usual garden mulching practices, wherein mulch materials decay at the soil surface, and gradually incorporate themselves into the soil.

Grass Clippings

Grass clippings constitute a mulch of sorts and deserve discussion here. Wheth-

Courtesy Toro Mfg. Co.

Leaf mulching attachment on rotary mower provides a practical and efficient way to dispose of leaves; it chops leaves into small bits which settle into the grass and provide a mulch for the lawn.

er to remove them or to let them remain on the lawn is dependent, to some extent, on the personal preference of the homeowner and, to a larger extent, on the kind of lawn grass and the geographic location of the home site. In terms of lawn culture, it is still a moot question whether grass clippings are advantageous to the lawn.

When grass clippings are left on the lawn, they gradually work down to the soil and at least partially decay, according to the same general principles as a garden mulch. But the amount of mineral plant-food elements returned to the soil in this manner is negligible, so the necessity of periodic fertilization is not eliminated. Unlike the mineral elements, nitrogen, the element so essential for good turfgrass growth, is largely released t the atmosphere and thereby lost.

Under most conditions, if the lawn is cut frequently enough so the clippings are always short, they may well be left on the lawn. During periods when lawn grasses are growing most rapidly it may be necessary to mow the lawn from one to three times a week in order to keep i properly groomed. The gray stubbly appearance of some lawns a few days after mowing is generally a sign that too much leaf area has been removed and that the mower has cut into the stems.

Clippings which are over 1 inch long as well as wet and matted clippings should always be removed from the lawn they will not work down through the grass. Instead, as they dry out and turn brown, the lawn will appear dull and unsightly. In addition, heavy clippings may smother the grass and create conditions that are highly favorable to disease. However, clippings removed from the lawn may be used to mulch shrub and flower beds or be deposited in the compost pile *They are too valuable a source of organic matter to be burned.*

Grass Clipping Mulches to Avoid

Some grasses possess certain inherent characteristics, which for one reason o another, make it advisable to remove th clippings when possible. The chemica composition of grasses such as fescue and zoysias is such that decompositio proceeds very slowly. The stoloniferou habit of growth plus the vigor of suc grasses as creeping bent, Bermuda (especially the fine-leaved types) and St Augustine results in the production of very dense turf, which prevents clipping from settling to the soil line. The vigo and the lateral growth habit of Merio bluegrass, coupled with its production o numerous rhizomes, likewise results in dense turf through which clippings settl only with difficulty. In all cases wher these or similar grases predominate re moval of clippings is always recommended.

If the clippings from these grasses are permitted to remain, it is essential that the lawn be cut frequently, aerated periodically when the grass is growing most actively, maintained at a high level of fertility and adequately supplied with moisture. This will encourage decomposition of the clippings and prevent a build-up of "thatch," a spongy layer of undecomposed material which encourages shallow rooting and disease. This thatch develops only occasionally if the clippings are removed. In any case, *thatch does not constitute a lawn mulch and is to be avoided.*

Geographic location is also a factor in deciding whether to mulch a lawn with grass clippings. The breakdown and decomposition of clippings or other organic material applied to the lawn is entirely dependent upon microbial activity. Because the activity of microorganisms is dependent on the prevailing temperature and moisture conditions, geographic location plays a major role in thatch development and the disposal of clippings. When temperatures drop below 54°F., little decomposition occurs. Lawns located in cooler climes are therefore much more prone to develop thatch and, because of the shorter and cooler growing seasons, thatch tends to accumulate on these lawns to a greater extent than on lawns in warmer areas. In cooler sections, having short growing seasons, *removal of clippings from lawns is often desirable because of their slow decomposition.*

Sources of organic matter suitable for lawn mulches are treated in PLANTS & GARDENS, Spring 1956, page 38. In general, decomposed (composted) tree leaves, which have been pulverized and screened or sieved, make an excellent and relatively weed-free source of organic material. Moreover, use of tree leaves means that the mineral plant-food elements obtained from deep in the soil by deeply penetrating tree roots, are not lost. Mulching leaves where they fall (with a rotary mower attachment) is a practical and efficient method of leaf disposal (see illustration opposite). Returning the pulverized leaves to the lawn insures an annual application of organic matter.

If one is thinking of lawn mulches in terms of their contribution to building up the organic content of the soil *under* the lawn, good fertilization practices may well be more valuable. Adequate fertilization continually promotes the growth of new grass roots, and old roots are constantly dying. As the dead roots decay, they become the dead organic matter we talk so much about, and they are already incorporated into the soil!

* * *

SAWDUST FOR LAWNS

Sawdust may be used instead of straw on a newly seeded lawn. It is less likely to be blown around by the wind and will not contain weed seeds as is usually the case with straw. It helps prevent crusting of the soil and thus allows the young grass seedlings to easily break through the surface.

Use a very thin layer of sawdust, only about $\frac{1}{8}$-inch thick. You should be able to see the soil through the sawdust. A thicker layer may tend to crust over and prevent the grow of the small grass seedlings. Do not use shavings or wood chips on a newly seeded lawn.

There is no advantage in using sawdust on an established lawn; it will *not* work down into the soil.—W. P. J.

WITHIN THE BROOKLYN BOTANIC GARDEN

International Flower Show Exhibit at the New York Coliseum, March 31 to April 10

A small Japanese garden adapted from a 200-year-old plan by Akisato Rito was the Botanic Garden's exhibit at this year's Intenrational Flower Show in New York's new Coliseum. The exhibit was formally opened by Miss Kimiko Tateishi of Tokyo, a student at Packer Collegiate Institute, and Japanese Consul General Jun Tsuchiya and Mrs. Tsuchiya. The garden was planned and executed by members of the staff of the Botanic Garden under the guidance of Miss Alys Sutcliffe and Mr. Frank Okamura.

In this garden, as in Japanese gardens in general, the feeling of an entire landscape was concentrated into a small area by carefully controlling the size, shape and location of all objects in it.

Plants were used with restraint, and so arranged as to best display their form and texture. Flowers are used in Japanese gardens, but not so lavishly as in western gardens—in some they are omitted altogether. Ground covers of lily-of-the-valley funkias, and dwarf iris, and stretches of swept sand were used in place of lawn, which is seldom found in Japanese gardens.

Stones, carefully selected and placed, were a basic part of the design of the garden. In Japanese gardens each stone used has a symbolic meaning and is chosen and placed accordingly.

The small garden in the exhibit demonstrated that it is possible to have a Japanese garden in a small space, such as a city back yard or a secluded corner of a suburban or country garden. Bonsai, the dwarfed potted trees of Japan can be attractively displayed in such a garden. In the exhibit about fifty of these trees from the Botanic Garden's large collection were displayed on what might be the veranda of a house.

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PLANTS & GARDENS

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Cuttings

Hardwood
Cuttings

Layering

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SUMMER
1957

New Series
l. 13, No. 2

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PLANTS & GARDENS

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Published quarterly at 3110 Elm Avenue, Baltimore, Md., by the **Brooklyn Botanic Garden, Brooklyn 25, N. Y.** Entered as second-class matter at the post-office at Baltimore, Md., under act of August 24, 1912. Subscription included in Botanic Garden membership dues. To others: $2.00 per year; $3.75 for two years. Copyright, 1957, by the Brooklyn Botanic Garden.

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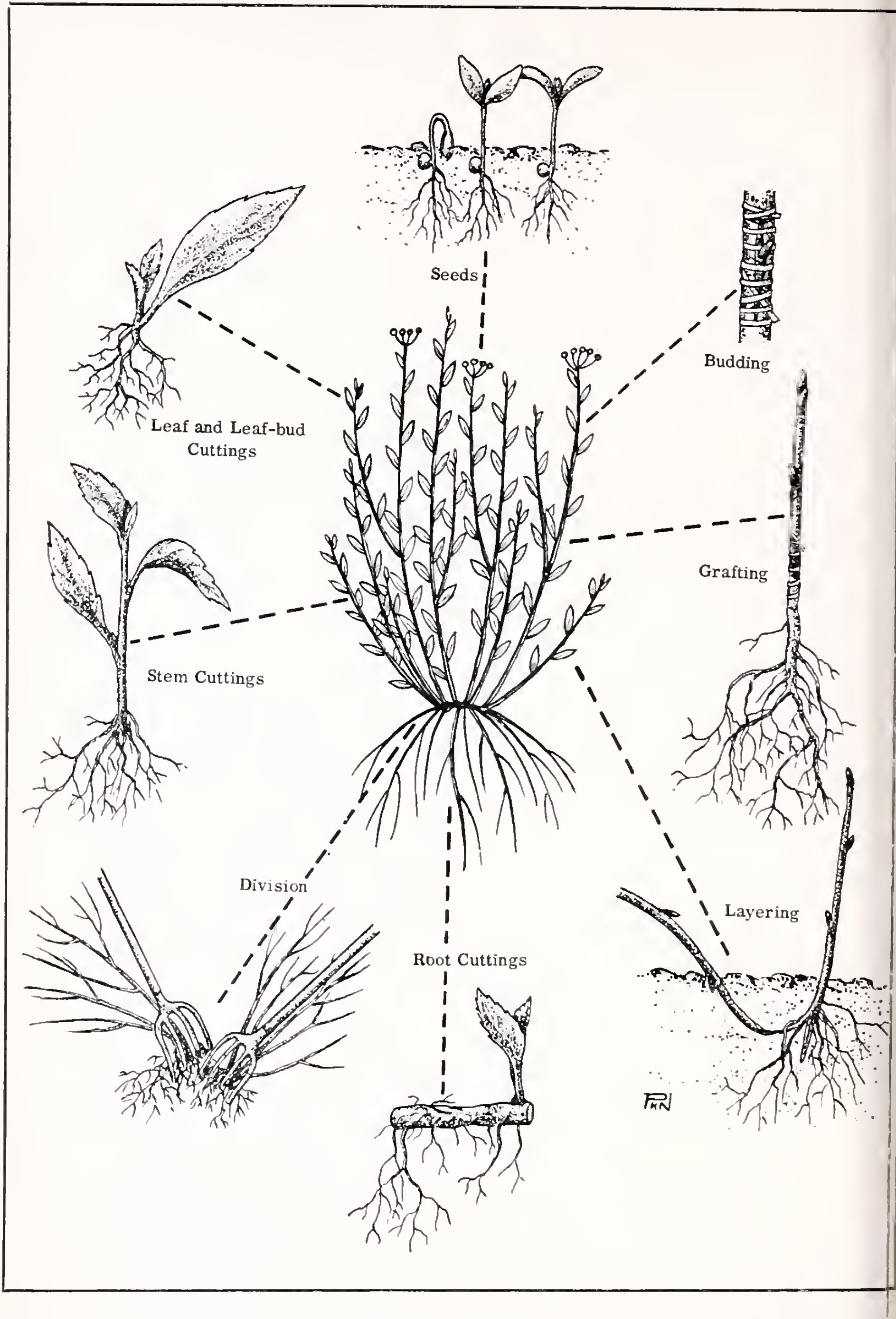

Commonly Used Methods of Propagating Plants
Except for Seeds, these are all vegetative methods of propagation.

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Summer 1957

It is with happy satisfaction that we publish this Handbook on Plant Propagation. Guest Editor Lipp and cooperating authors have, in the judgement of our Editorial Committee, done a splendid job of bringing together the facts that every amateur gardener and horticulturist wants to know.

Except for the refinements of modern equipment, basic propagation techniques have been known for tens of centuries. The rooting of cuttings, grafting and budding all are recorded in Pliny the Second's **NATURAL HISTORY**, written in the first century A.D. Along with well verified facts Pliny mixed spurious statements, yet his **NATURAL HISTORY** deserves passing notice in this 20th century. There is little doubt that men were rooting cuttings and grafting olive and fig trees in the era of the building of the pyramids. Today almost everyone, without awareness of history, makes many re-discoveries of what was known to his forebears of 200 or more human generations ago.

The practices of grafting and budding provide exciting opportunities, and make it possible to perpetuate a chance discovery of some new variety. Here is the way it might work out. If one plants seeds from a desirable variety of apple, peach, or any cultivated fruit, the chances are probably a million to one that they will grow into mongrel plants, i.e., for all practical purposes, the seeds never come true. But the "one in a million" may be a new find, a desirable new variety. If so, it can be perpetuated by grafting. Likewise, if a single branch of a tree differs from all other branches (a "sport" or mutation) and has outstanding flowers or fruit or other desirable characteristics, a bud from this branch can be grafted on closely related stock, and thus perpetuated.

Once such a desirable new variety of any plant is found, all its grafted offspring are a vegetative continuation of the original, and not really "offspring" at all. Thus, if there had been a McIntosh variety of apple in biblical times, and if it had been grafted from time to time in the intervening centuries, the same McIntosh variety would have been available over a span of twenty centuries. All the trees would have been the same, though perhaps separated by hundreds of years in their individual lives. They would all have belonged to the same "clone." Understanding this word, and its use, therefore becomes simple. To understand the meaning of the word clone is to understand the significance of grafting and budding. This principle is something every amateur gardener and horticulturist should know.

Yours sincerely,

George S. Avery Jr.

Director

THE WHYS OF PLANT PROPAGATION

As every gardener knows, seeds are the commonest means of reproduction in flowering plants. Seed production is basically a sexual process, involving the union of sperm and egg cells before the seeds are finally formed.

Rapid and vast increases in the number of plants can be brought about by means of seeds. A commercial grower, starting with five seeds of a certain variety of bean, was able in 6 successive harvests to produce 10,000 pounds of these beans.

But in addition to being propagated by seeds, most plants can be multiplied in other ways—for instance by runners, as in the case of strawberries, or by bulblets like those at the bases of the leaves of some lilies. These are vegetative methods of propagation and do not involve sex cells. Some, as in the examples mentioned, occur naturally; others have been devised, or at least greatly improved upon, by man. The most widely used and important of these methods are pictured in the frontispiece.

In terms of our present knowledge of living things, there are a number of interesting facts linked to the practice of vegetative propagation. Every plant is made up of living cells and, theoretically at least, each of these millions of tiny cells, whether in a dandelion, chrysanthemum or apple tree, has all the potentialities of the entire plant. Thus a slip from a branch or a piece of root, once severed from the parent, can under the right conditions, regenerate lost parts and become a complete new plant. Up to a certain point the same facts hold for the animal kingdom. A salamander can regenerate a lost leg, or a lobster a lost claw. But only among some of the lowest animal is the ability to form a whole anima from a small part found. Higher animals, including man, cannot even regenerate lost parts. Yet this capacity for regeneration in higher plants is the ver essence of vegetative plant propagation

Since seed production is so nearly universal among flowering plants, which include practically all those grown in cultivation, and is such a simple method o propagation, one may well ask why resort to vegetative propagation at all There are numerous reasons. An obviou one is that some valuable plants, especially certain hybrid varieties, are steril and cannot produce seed. For these vegetative propagation must be relied upon. Other hybrids may set abundant see but the resulting offspring do not necessarily resemble the plants from whic they come. Therefore, in order to perpetuate the desirable hybrid characteristies of the parents, vegetative propagation must be used. In many cases th use of vegetative methods of propagatio is simply a matter of saving time—matur plants can be obtained more quickly b these methods than by planting seed.

Why not resolve here and now to star a whole series of experiments on propagation? The use of plastic film alone enough to spur the interest of any amateur. As a starter for September, set u a flat of cuttings of several different kind of holly, or perhaps some other favorit shrub that roots at this season as described on page 97; don't bother to wate or even look at them for 8 or 10 week The results will be amazing. But this only one experiment, and it is hoped tha this Handbook will suggest many.

ROOTING SOFTWOOD CUTTINGS

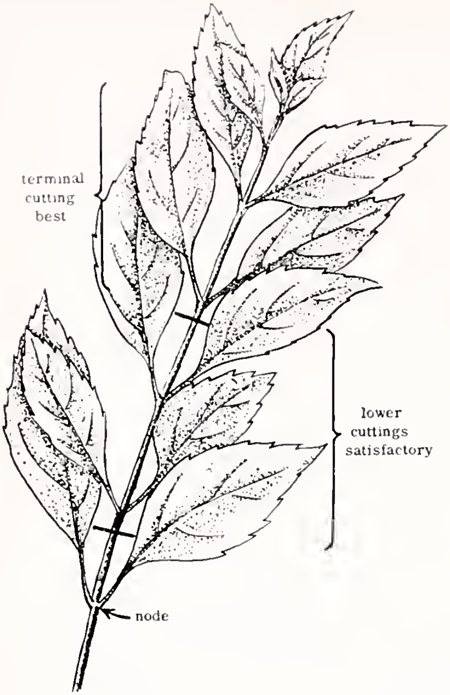
An easy, widely practiced method of propagating plants

Propagation by means of softwood cuttings is a simple method of multiplying many kinds of trees and shrubs. The softwood cuttings are ones made from the current season's growth with nearly mature foliage (the leaves are unfolded and beginning to darken in color). With proper treatment and modern techniques, such as the use of root-inducing hormones, softwood cuttings of many woody plants formerly propagated only by grafting can now be successfully rooted. Typical examples are magnolia (*Magnolia* spp., Asiatic maples (e.g. *Acer japonicum*, *A. palmatum*, etc.), and pink flowering dogwood (*Cornus florida rubra*).

Softwood cuttings of deciduous plants, such as lilac (left) can be taken in late spring and summer; those of most broad-leaved evergreens such as holly (center) and of conifers such as fir (right) can be taken in summer, fall or winter.

Time to Take Cuttings

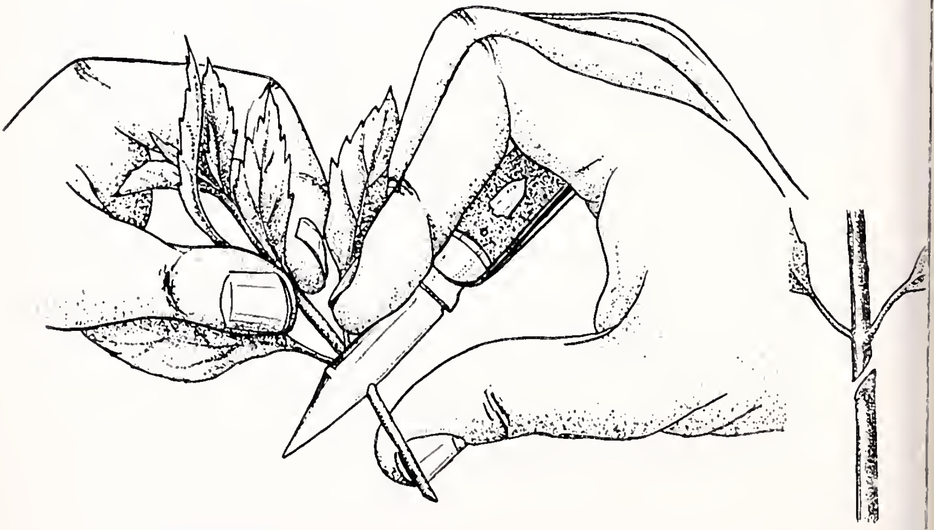
There are no hard and fast rules as to when softwood cuttings should be taken, but in general cuttings of deciduous plants (those which lose their leaves in winter) are taken in late spring and summer, those of broad-leaved evergreens and conifers in summer, fall, or winter.



Terminal sections are best for softwood cuttings but long shoots can be cut into several sections.

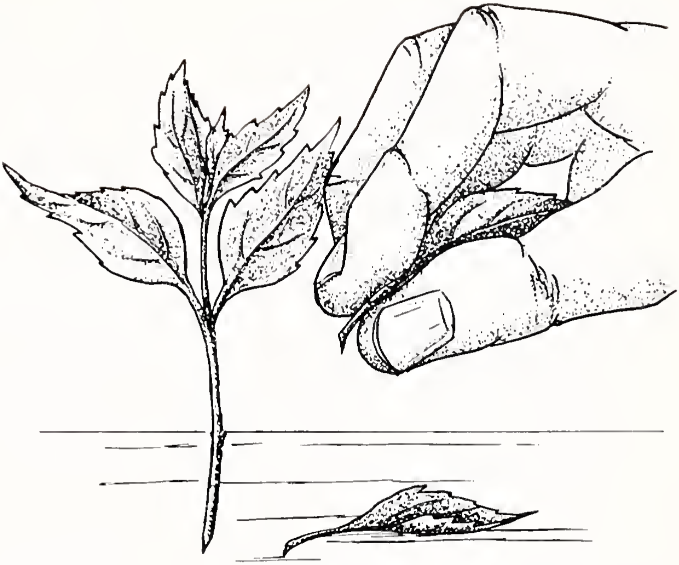
Making the Cuttings

Early morning is the ideal time for making the cuttings. Terminal parts of the stem are best, but a long growth can be cut into several sections. In preparing the cuttings, it is best to work in a cool, shaded place. Cuttings are made from 2 to 6 inches in length, depending upon the material. Short ones with reduced foliage are less apt to wilt than longer ones. A sharp, thin-bladed pocket knife is the best tool for making cuttings. With it the stems are cut on a 45° angle. The cut is usually made about a quarter of an inch below a node (junction of leaf and stem), but this can be varied considerably.



To make cuttings, stems are cut on 45° angle with sharp knife.

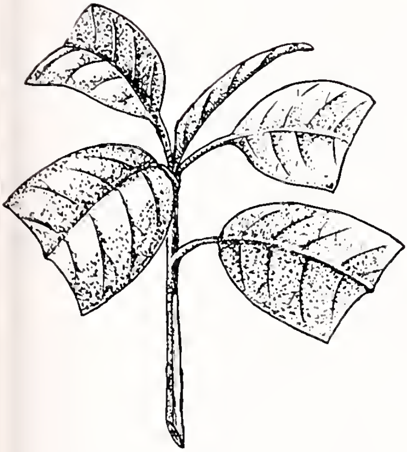
The leaves on lower third of cutting are removed.



About a third of the leaves at the base of the cutting are removed. On large-leaved plants, such as rhododendron, the remaining leaves can also be trimmed.

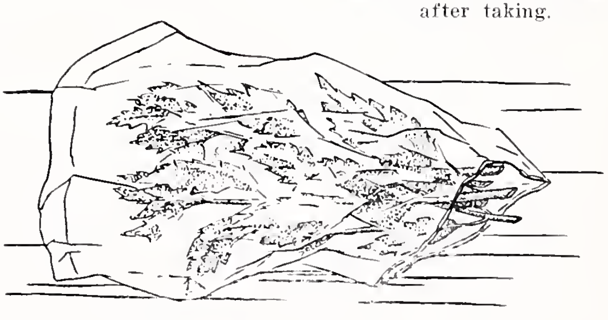
As fast as the cuttings are prepared they are placed between moist papers or cloths, or in a polyethylene bag. They should be planted without delay, but if necessary they may be stored for a time in a refrigerator, in a plastic bag.

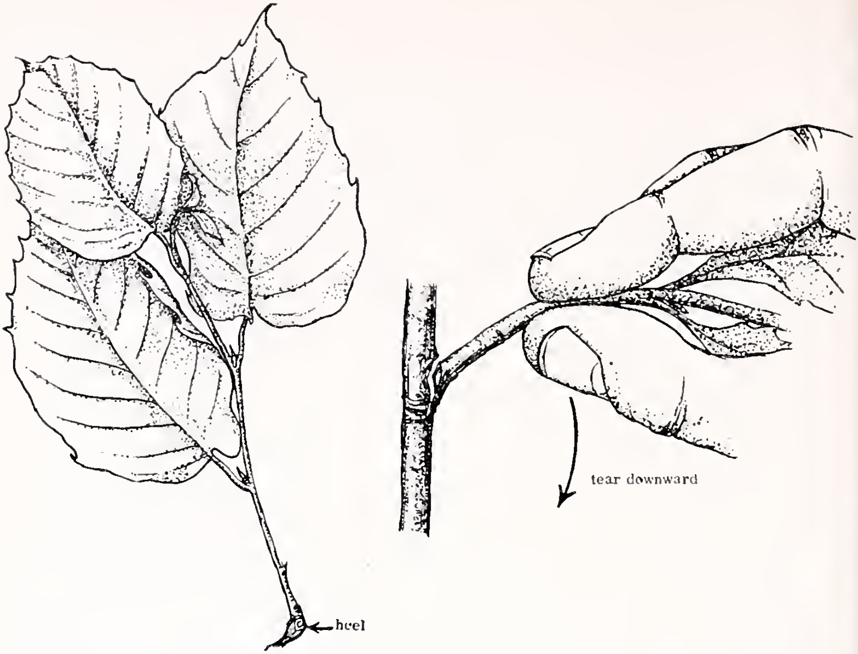
Cuttings of some plants, such as *Cytisus*, *Corylopsis* and *Coronilla*, are found to root better if thin side shoots are taken with a slight "heel." This is done by tearing the cuttings from the parent plant with a downward pull.



Large leaves such as those of rhododendron can be clipped to about half size to reduce surface.

Cuttings are placed in polyethylene bag or between wet papers immediately after taking.





Some cuttings are best if taken with a ''heel.'' This is done by pulling side shoot downward from main branch.

Root Promoting Hormones

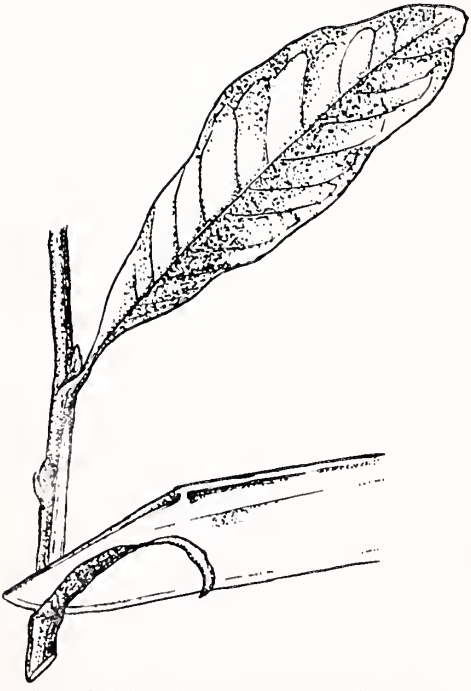
Hormones to induce the growth of root on cuttings are available under severa trade names. In general, powders ar the best for amateur use. Follow th manufacturers' instructions.

An approved practice with many plants for example rhododendrons, maples, magnolias and deciduous azaleas, is to woun the base of the cutting before applyin the hormone. This is done by drawing sharp knife down the base of the ste for a distance of one or two inches, jus deep enough to expose the active tissu (cambium) beneath the bark.

Rooting Materials

A good rooting medium is one whic can easily be kept uniformly moist, bu which also provides good drainage an aeration. Some satisfactory ones are

clean sharp sand (builders' grade
vermiculite (horticultural grade, sol
under several trade names such
Terralite, etc.)
perlite



Before dipping in hormone powder base of cutting may be wounded by cutting away thin strip of bark.

sand and peat moss mixture, equal parts of each

equal parts of sand, peat moss and powdered styrofoam

The last named mixture is especially good for many acid-loving broad-leaved evergreens. A few very easy subjects can be rooted in water alone, but most shrubs cannot. Roots which do develop in water tend to be very brittle.

The rooting medium can be placed in small boxes or greenhouse flats, bulb pans or flower pots, plastic boxes, cold frames, or in specially prepared beds in shady spots out-of-doors. Recently developed aids to rooting cuttings are the use of plastic film (see page 96) and mist (see page 102).

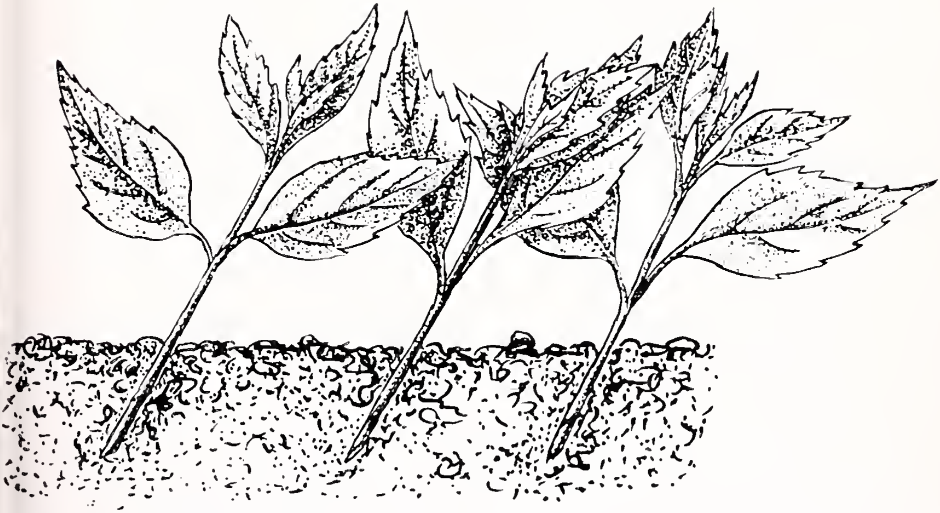
Inserting the Cuttings

Before inserting the cuttings the medium should be moistened. Cuttings are inserted to about ⅓ their length if they are to be placed where the humidity can be kept high, to about ½ their length if planted in the open. They are inserted on a slight angle, and just far enough apart to permit all leaves to receive light. The long established practice of firmly tamping the medium about the cuttings is no longer considered to be necessary. After insertion of the cuttings, the medium is again watered, and this washes the particles closely about the bases of the cuttings. Mixtures containing peat moss should be watered only moderately, as the peat absorbs a great deal of water and tends to remain too wet.

Care During Rooting

During rooting the medium must be kept uniformly moist, but never soggy. For the first 7 to 10 days the cuttings should be lightly shaded—a cover of moist cheesecloth is good. Glass in cold frame sash can be whitewashed, or covers of lath or canvas can be used. After cuttings are established, the shade can be gradually reduced. Cuttings of many broad-leaved evergreens will root in partial shade; most deciduous plants need more light.

If cuttings are in closed containers, ventilate enough to prevent growth of fungi. After cuttings are rooted, the covering should be removed for increasing periods of time until it is finally left off entirely.



Cuttings are inserted into the medium on a slant, and from one third to one half their length.

Flower pot covered with plastic bag makes small "greenhouse" for rooting a few cuttings.

Single cuttings can be covered with glass jar while rooting

Plastic refrigerator box makes convenient rooting chamber for cuttings.

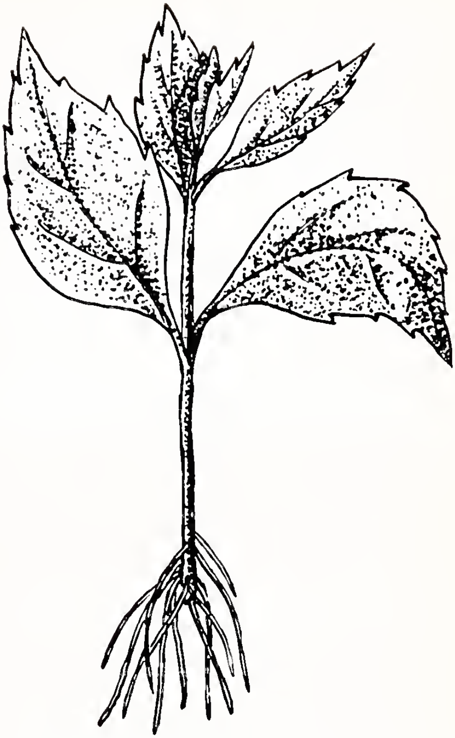
After Rooting

When the roots of the cuttings are from ½ to 1 inch long they can be transplanted to pots or directly to outdoor beds. Remove them carefully to avoid breaking the brittle roots—a wooden pot label is a good tool to use. The best potting mixture consists of two parts loam, one part sand, and two parts peat moss. Do not use any mineral fertilizer in the mixture. Center the stem in the pot and firm the soil gently about the roots. Water well and shade for 7 to 14 days. After this increase the amount of light.

By fall many of the cuttings will be ready for planting directly in the field. If they were rooted late in the season, they can be placed in a cold frame the first winter.

In planting rooted cuttings directly from the rooting medium to outdoor beds they should be spaced 6 to 12 inches apart. When the plants begin to crowd they can be transplanted. Cuttings placed directly in outdoor beds will need shading longer than those first grown for a time in pots.

Some woody plants such as magnolias, maples, pink flowering dogwood and some viburnums are easy to root, but difficult to overwinter. The best solution is to root the cuttings as early as possible so that they are well established by winter. The rooted cuttings are placed where the temperature is just above freezing, but below 45° F. throughout the winter. They are kept on the dry side until the middle of January, then given more water and heat.



Rooted cutting ready for transplanting.

Plants Commonly Rooted from Softwood Cuttings

*Arbor-vitae (take in fall)
Azalea (evergreen)
Barberry (*Berberis*) (deciduous)
*Barberry (evergreen)
*Box (*Buxus*)
Butterfly-bush (*Buddleia*)
Cotoneaster
*Creeping junipers (*Juniperus*)
Dogwood (*Cornus*)
Deutzia
*English ivy (*Hedera*)
*Euonymus
*Firethorn (*Pyracantha*)
Forsythia
*Gardenia
Ginkgo
*Holly (*Ilex*) (evergreen)
Honeysuckle (*Lonicera*)
Hydrangea
Jasmine
Japanese creeper or Boston-ivy (*Parthenocissus tricuspidata*)
Kerria
Lilac (*Syringa*) (taken soon after flowering)
Mahonia
Metasequoia
Mock-orange (*Philadelphus*)
*Osmanthus
Pachysandra
Pieris
Privet (*Ligustrum*)
Rose (species)
Spirea
St. Johnswort (*Hypericum*)
Virginia creeper (*Parthenocissus quinquefolia*)
Viburnum
Weigela
Willow (*Salix*)
Winter hazel (*Corylopsis*)
Wisteria
*Yew (*Taxus*)

*May be taken as late as fall and mid-winter.

PROPAGATION BY HARDWOOD CUTTINGS

Quick and easy for the gardener

Roy M. Nordine

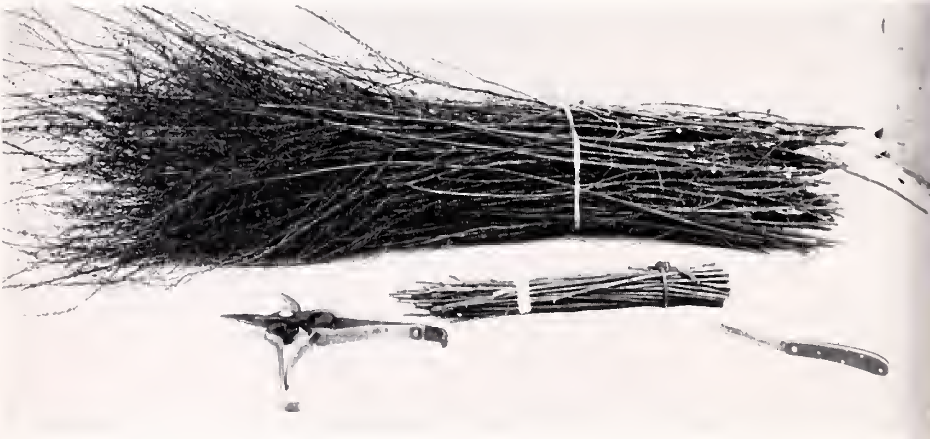
FOR propagation of woody plants by hardwood cuttings, the current season's growth is generally used, either the long canes that grew up from the base of the plant or the new growth on the ends of the branches. These canes may be gathered soon after the dormant season has begun, or any time until late winter. Material from plants that may be injured by severe winter weather should be gathered before temperatures have dropped.

Storage of Canes

The canes may be made into cuttings at the time of gathering, or stored until later in a cool place, below 50° F.—even at freezing temperatures. It is not necessary to bury the wood, or to put the cut ends in moist material; but the canes should not at any time be subjected to drying conditions such as higher or fluctuating temperatures, drying winds, or any circumstance that may draw the moisture from them. It is equally important to prevent excessive moisture near the stored material. The ideal way to store the canes is to bury them in a generous quantity of moist but not wet material, such as peat, sand, wood shavings, sawdust, sphagnum moss, or vermiculite.

Cuttings

Cuttings are ususally 6 to 8 inches long, and can be made with a knife or with pruning shears. Cutting just below a node or bud is usually of no great importance; but plants with hollow stems or large spongy pith should be cut just below a node or bud. Cuts may be made either straight across or with a slight slant. The upper end of the cutting should be an inch or so above a bud,



Suitable branches for making hardwood cuttings, and bundle of cuttings ready for storage.

henever possible. This prevents injury the top bud, should the cutting become ry or die back; it also offers mechanical rotection against injury at planting time. he diameter of the cutting is of no great nportance, except that very thin wood nd the late growth on the tips do not nake cuttings that survive the storage me. The ideal cutting is of lead-pencil ze, both in length and in thickness. uttings should be made so that they may ave six to eight weeks of storage time efore planting.

The finished cuttings are gathered into undles of convenient size. Tap the botom of the bundle on a flat surface to vel it, label it, and tie it with stout cord r fine wire. The bundles are then uried. They may be placed in either a orizontal or a vertical position. The first iree or four weeks of storage should be t 50°-55° F., at which temperature the ut ends quickly callus (i.e. form a soft ound-healing growth known as *callus*). fter that, the temperature is dropped elow 40° F. but above 32°, to keep the ops from growing too soon.

McFarland photos

Bundles of hardwood cuttings ready to be buried for storage until spring.

Planting

The cuttings should be placed in the round as soon as the soil is workable. t is best to set them in full sun. They iay be set 9 inches apart, in rows 2 eet apart, and left for several years. Or they may be set 6 inches apart, in rows a foot apart, and removed after one season. If a hedge is planned, the cuttings may be set into their permanent location immediately. A tool should be used to make an opening in the ground just wide enough to take the cutting and deep enough to place the top bud at the soil surface. Firm the soil around the cutting.

The percentage of cuttings that grow will vary considerably, depending on many circumstances; but results of 80 per cent are excellent.

The hardwood cutting technique works well on these:

utton-bush (*Cephalanthus*)
urrant (*Ribes*): varieties with edible fruit
eutzia
ogwood (*Cornus*), except the Flowering Dogwood
lderberry (*Sambucus*)
uonymus: a few varieties
ig (*Ficus carica*)
olden-bells (*Forsythia*)
oneysuckle (*Lonicera*)
ndian-currant (*Symphoricarpos orbiculatus*)
asmine, or Jessamine (*Jasminum*)
Kerria
Matrimony-vine (*Lycium*)
Mock-orange (*Philadelphus*)
Mulberry (*Morus*)
Ninebark (*Physocarpus*)
Persian Lilac (*Syringa persica*)
Poplar (*Populus*)
Privet (*Ligustrum*)
St. Johnswort (*Hypericum*)
Snowberry (*Symphoricarpos albus*)
Spirea (*Spiraea*)
Tamarisk (*Tamarix*)
Weigela
Willow (*Salix*)

PLANT HORMONES

Their use speeds the rooting of cuttings

George F. Ryan

TREATMENT of stem cuttings with synthetic plant hormones to promote rooting is an accepted practice with many propagators, both commercial and amateur. These hormones are chemicals which, in extremely small concentrations, are capable of greatly affecting growth. The ones that are of interest to plant propagators are those which have been found capable of inducing or stimulating the growth of roots on cuttings.

Chemicals Used

The chemical which probably has been most widely used for treating cuttings is indolebutyric acid (referred to as IBA). It is a safe and effective root-promoting substance for a wide range of plants. Alpha-naphthaleneacetic acid (NAA) and the closely related naphthaleneacetamide (NAd) also are used extensively. They are effective on many plants at approximately the same concentrations as IBA. There are many others, including 2,4-D, but they are little used for rooting cuttings. Indoleacetic acid, the first naturally-occurring plant hormone to be used for stimulating rooting of cuttings, is now seldom used. It is generally less effective than the other compounds.

Mixtures of the active chemicals occasionally have been found superior to the optimum concentration of any one of them alone.

Method of Treatment

Various methods have been used for applying these root-inducing substances, but the most widely used is the technique of dipping the cuttings in the hormone powder. Most commercial preparations are now in this form, with the chemical mixed with powdered talc at suitable co centrations. Some of the trade-na preparations contain a fungicide to gi protection against diseases. In usin these, the base of the cutting is dippe ½ to 1 inch in water, then into the pow der spread on a paper or in a small co tainer. Very hairy or juicy cuttings nee not be moistened first.

The useful range of concentrations f IBA or NAA is approximately 0.1 p cent to 0.8 per cent (in talc) for sof wood, semi-hardwood and hardwood cu tings of most plants. As high as 2 p cent IBA has sometimes been helpful o cuttings of certain varieties, such as som camellias, rhododendrons and yews. Som of the commercial preparations come i a range of concentrations, and the manu facturers supply lists with each tellin for which plants it is most useful.

Effects of Growth Regulatory Hormones

Cuttings of many plants which ro fairly well without treatment respon when treated by producing more roots less time. This saving of time is a pra tical advantage to the commercial prop gator. In many cases there is also a be ter distribution of roots along the cuttin resulting in a desirable root system whi handles well in potting.

Some varieties which normally ro poorly, both in quality of root syste produced and in number of cuttings roo ed, will respond by producing better roo in less time, and also by rooting in sati factory percentages.

Plants which cannot be rooted at without the use of hormones cannot

ases of cuttings are ipped in hormone owder and excess powder shaken off.

Hormone powders an be obtained under uch trade names as ootone, Hormodin, etc.)

ooted simply by applying growth reguators.

An undesirable effect occasionally reulting from treatment is retarding of hoot growth after the cutting has rootd. This may happen when too high a oncentration or too much of the chemial is applied. Ordinarily it is not a serius problem. Stem injury may also occur f a treatment is too strong for a paricular variety. The lists provided with he commercial preparations give the optimum concentrations for treating most plants the amateur will be working with. When the proper concentration is not known, serious loss of cuttings from overconcentrations can be avoided by small-scale trials with a series of concentrations.

Enthusiasm over the use of chemical treatments to promote rooting has sometimes caused propagators to disregard the fact that as much care in the selection and handling of cuttings is required for success with these chemicals as without them.

McFarland photos

reated cuttings are nserted into rooting edium carefully to void brushing off hormone powder.

USING PLASTICS IN PLANT PROPAGATION

Polyethylene film has greatly simplified many propagating techniques

George Taloumis

WITH the advent of polyethylene plastic film a few years ago, the propagation of all kinds of plants, including the more difficult woody types, has become an easy and commonplace practice with home gardeners all over the country. When hitherto the rooting of yew, holly, rhododendron, azalea and other kinds of cuttings was possible primarily for those who possessed greenhouses, today these plants can be rooted easily, even in a city apartment.

All this and more has been made possible by polyethylene plastic, a material which has the all-important capacity of retaining moisture while permitting the passage of gases. High humidity, easily attained in a greenhouse, is next to impossible to duplicate in the average home. The capacity of the plastic to hold moisture for several weeks has also made increasing plants by air layering quicker, as well as more effective.

A Plastic Miniature Greenhouse

To most home gardeners polyethylene plastic is a blessing because with it he can make a miniature "greenhouse" of his own. To do this, simply take a wooden tray (such as a greenhouse flat), place a wire or bamboo frame over it and cover with a large sheet of plastic, tucked under the base to hold it in place. Within it both hardwood and softwood cuttings of many kinds of plants can be rooted (see photograph on opposite page). Azalea cuttings will root in about four weeks, lilacs require three and rhododendrons, which are difficult compared with others, require about five. Before inserting the cuttings in a medium containing equal parts peat moss and sand, dip the en in hormonal root-promoting powder hasten rooting.

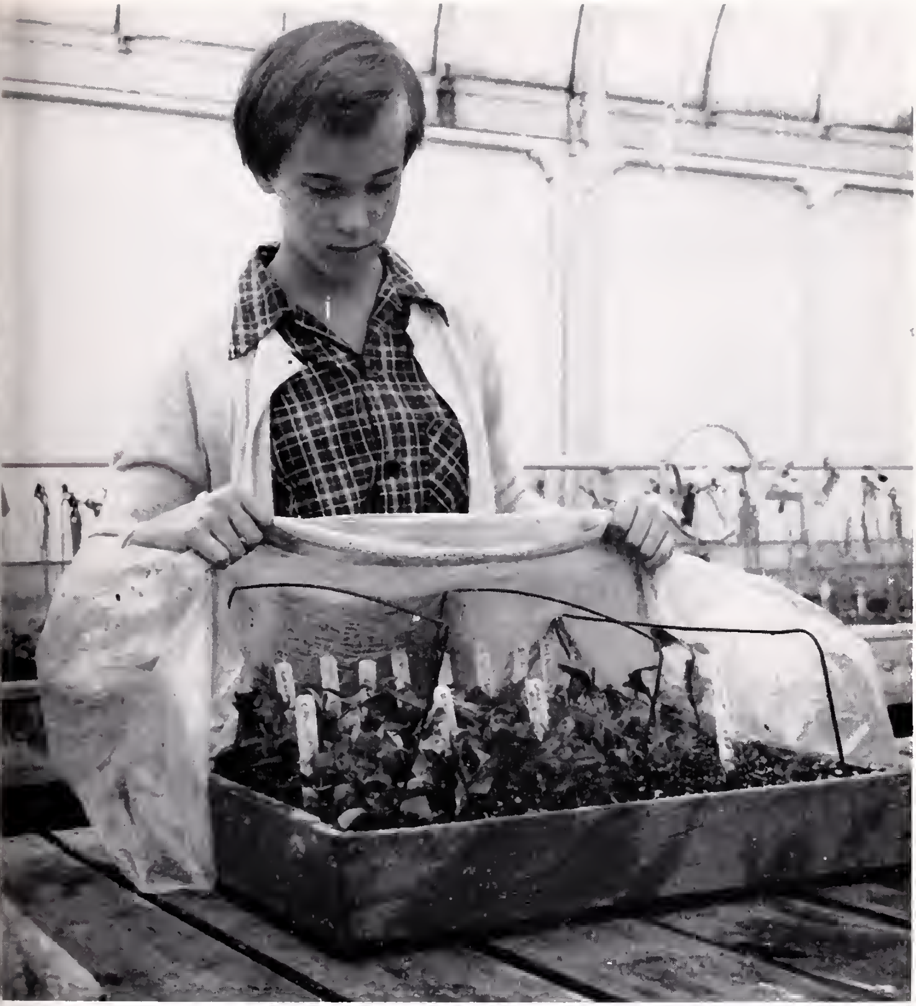
After being watered well, the rooti medium will not require additional app cations of water for several weeks. T home gardener can go off on a trip a return to find his greenhouse still moi Indoors, the unit may be kept in a we lighted window, but away from h bright sun, especially during the summ During the hot months it can be plac outdoors under large shrubs or trees wh it will receive some sun during early late parts of the day. This simple a useful method of propagation can be a plied to practically all kinds of har woody garden plants.

The unit can also be used for starti seeds. It is particularly recommended f seeds that are difficult and require a gr deal of time to germinate (see page 12

For those not caring to make a unit a wooden tray, a small clay pot can used in a similar way. Fill it with t same rooting medium and cover with polyethylene bag, such as is used in pa aging fruits and vegetables. A single c ting or perhaps two or three can be serted in the pot.

Plastic for Rooting Single Cuttin

A small piece of polyethylene plas is also handy in rooting individual c tings. This method is especially use in the home where the propagating u might take too much space or prove be unattractive. Place a small amount moistened sphagnum moss in a squ piece of plastic, and insert the cutt after first dipping the end in a root-p



Lipp

ropagating unit devised by guest editor Lewis Lipp consists of greenhouse flat covered ith sheet of polyethylene plastic tucked securely under flat. Once properly set up such unit need not be watered or opened until rooted cuttings are removed. In partly opened nit shown here cheese-cloth is placed under plastic to provide partial shade for cuttings.

oting powder; then gather and tie the lastic around the stem of the cutting see photograph on page 98). When oots appear, the cutting can be planted ithout disturbing it at all.

House plants such as coleus, begonia, frican violet, peperomia, shrimp plant, luminum plant, gardenia and flowering aple can all be rooted simply and quick- by this method. Geraniums, for exam- le, will root in ten days. The little bundles can be placed on windowsills and other well-lighted places throughout the house, where they are out of the way.

Rolling Cuttings in Plastic

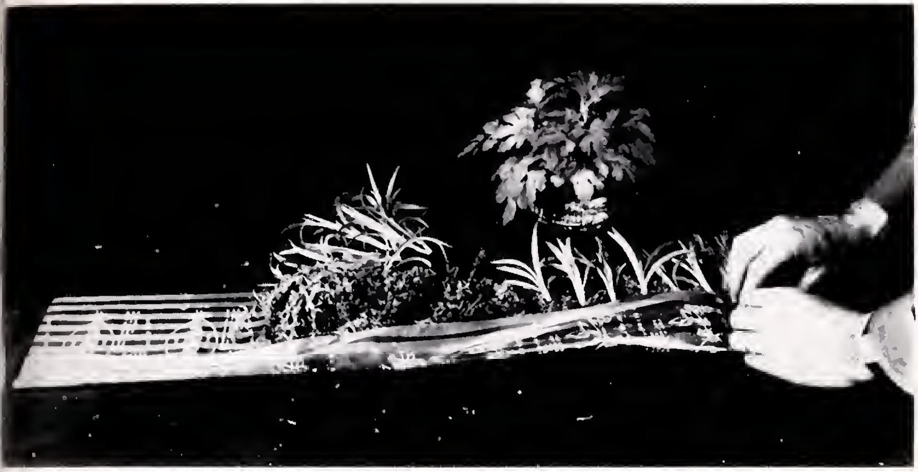
Another technique, known as the “roll method,” is practical because several cuttings can be rooted in a relatively small unit. Lay out a long strip of plastic and place moist sphagnum moss along the upper half. Then place the cuttings on the

Greenhouse propagating ben
covered with polyethylene fil

Singer

Courtesy Massachusetts Horticultural Soci

Single cuttings can be readily rooted in handful of damp peat moss or spaghnum, wrapp
in square of polyethylene film and tied. They should be given bright light, but not direct su



Courtesy Massachusetts Horticultural Society

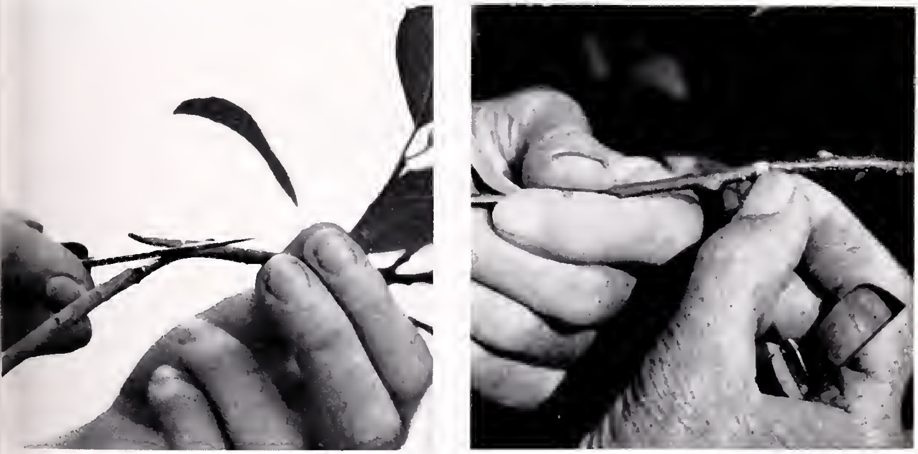
Roll method of rooting cuttings in polyethylene film.

oss, with the leafy tips projecting be-ond the plastic. Fold the lower part of he plastic up over the stems, roll up the lastic and tie with string (see photo-raph above).

As many as a dozen cuttings of chrys-nthemums, carnations, African violets r any other plant can be handled in this vay. The completed units will stand up n a windowsill and will not require additional watering or care until the cuttings have rooted.

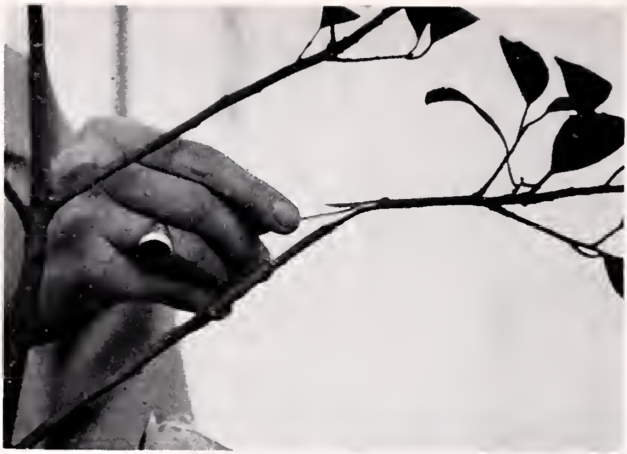
Plastic Aids Air Layering

Doubtless one of the most important uses of plastic is as a wrap for air layers. Before the advent of plastic the sphagnum ball surrounding the wounded stem was wrapped with burlap, which permitted the moss to dry out rapidly, especially



Taylor *Roche*

o begin air layer, healthy branch ¼ to ½ inch thick is chosen. Eight to twenty inches rom tip, twigs and leaves are removed for space of about six inches. Branch is wounded y making 1-inch cut about one third the diameter into the branch, or by removing small ring of bark (right) instead of making incision.



Taylor

Wound is treated wit rooting hormone powde here being applied wit wooden toothpick.

Handful of moist sphagnum is balled around wound.

Roc

Taylor

Sphagnum is wrapped polyethylene film.

Roche

Edges of film are folded together to close tightly.

Taylor

Ends of ball are firmly tied around stem with twine or rubber bands.

during hot summer weather. Air layering is a recommended method for propagating woody plants in the garden, such as dogwood, magnolia or holly, and for tropical plants which are difficult to root any other way, including dracaena, rubber plant and schefflera.

After making a slanting cut on the stem, or removing a ring of bark, place moist sphagnum moss over the wound, wrap with plastic and fasten upper and lower ends with string. When roots appear, sever the stem below the ball of moss and pot the new plant in soil. While the stem is rooting, the moss will probably not require moistening; however, this will depend on the type of plant, since some take several weeks longer to root than others.

Other Gardening Uses for Plastic

At vacation time those who grow house plants can use the plastic in another way. If a piece of plastic is wrapped around a clay pot and the ends fastened around the stem or base of the plant, the pot may be left for about three weeks, without needing additional water.

During this period, the soil will remain moist yet air will pass through the plastic to the roots. In tests conducted with potted florist's hydrangea, a plant requiring a great deal of water, pots that were covered with plastic were still moist after three weeks. Plants left in uncovered pots began to wilt in twelve hours.

Aside from its uses in propagation, polyethylene plastic has proved its versatility along other lines. For one, nurserymen are using it to cover the soil balls of trees, shrubs and other plants. Plastic is also proving to be an excellent mulch around fruit trees, vegetables and other crop plants (see PLANTS & GARDENS, Spring, 1957). Not only does the plastic reduce evaporation of soil moisture, but it keeps weeds under control. However polyethylene plastic is used, there is no doubt that it has revolutionized the field of horticulture and, in particular, it has done much to enable the home gardener to increase his stock of plants.

MIST PROPAGATION

An accepted technique among commercial propagators, simple mist systems are within the reach of home gardeners

Dale V. Sweet

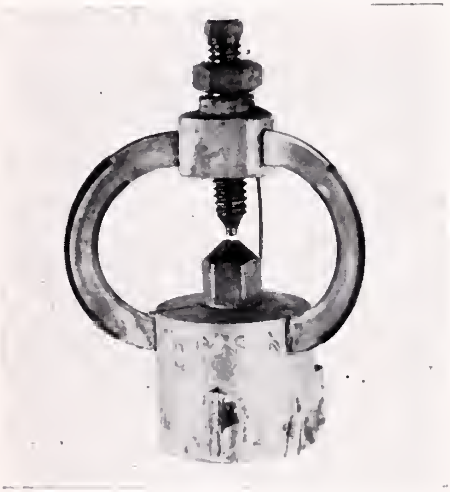
THE technique of rooting cuttings under a fine mist of water has developed mostly within the last ten years. By its use it is possible to root cuttings in full light and more or less open air, wilting is reduced, and rooting is rapid. Many plants that are difficult or impossible to root otherwise can be rooted under mist.

Constant Mist

The method as developed at first involves spraying the cuttings continuously with the mist. This constant mist system is a simple arrangement. The mist nozzles are adapted to either low or high water pressures, though most of those in use today are for low pressures. There are two distinct types. The oil-burner type produces a whirling, cone-shaped spray and can be purchased with mist angles of 80° to 180°. The deflection-type nozzle projects a fine stream of water against a flat metal disc, which disperses it horizontally into fine droplets. It is usually advisable to add a filter or strainer to the water line to reduce clogging of the fine apertures of the nozzles.

The nozzles may be connected to water lines suspended over the propagating beds, or placed on pipes rising vertically from the beds. They should be about 3½ feet above the rooting medium. One nozzle will mist an area of 9 to 12 square feet (3 ft. x 3 ft. to 3 ft. x 4 ft).

Buhle

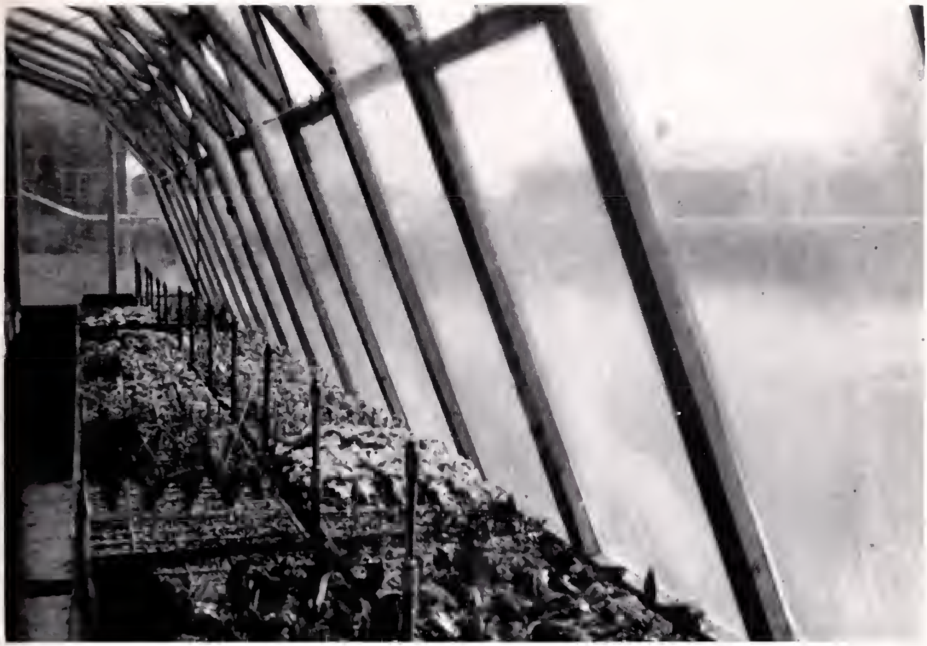


One type of nozzle for producing mist.

Intermittent Mist

Although very good results have been obtained with the constant mist systems, it has been found that better results are obtained by interrupting the mist at regular intervals. By applying the mist intermittently during the daylight hours—a few seconds out of each minute—the leaves are kept cool and the relative humidity sufficiently high to prevent excessive loss of water from the cuttings. At the same time the reduced flow of water permits the rooting medium to remain warmer and better aerated than under continuous mist. The method requires a solenoid water valve that is electronically or mechanically operated.

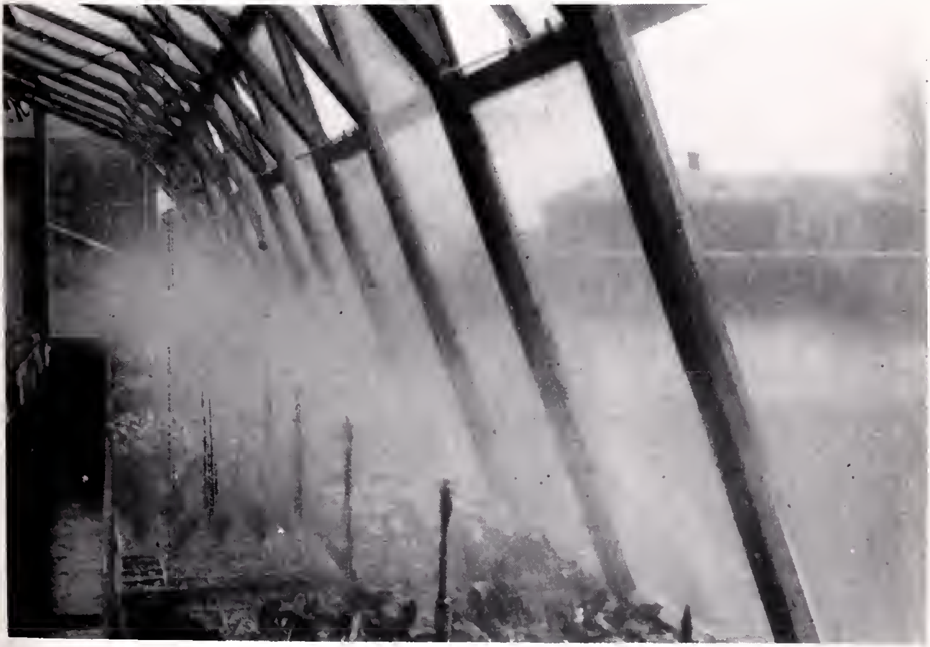
Many excellent methods have been suggested to control the periods of misting. The plastic leaf, the Livingston atmometer, and similar electronic devices have gained acceptance among some plant



Greenhouse bench with nozzles set on vertical risers from pipe line.

Mist produced by arrangement shown at top of page.

Photos author courtesy



propagators. However, adjustable mechanical control has certain definite advantages over these. In one such system the water line to the nozzles is connected to an electric solenoid valve which is operated by two clocks. The first clock determines the number of seconds per minute (or per each two minutes) that the mist is applied to the cuttings. The second one regulates the number of hours each day that the system operates. It is not necessary to apply mist at night, except perhaps in exceedingly dry climates. A great advantage of such mechanical control is that the amount of mist applied to the cuttings can be gradually reduced over the rooting period, and especially during the last week of rooting. This greatly reduces the shock the cuttings undergo upon removal from the mist bed, encourages more rapid root growth, and results in better survival after transplanting.

With mist propagation it is essential that very good drainage be provided for the propagation beds to prevent waterlogging. Three or four inches of coarse rooting medium over a gravel bed is satisfactory. The kind of medium used is not as important as its particle size or structure. For example, excellent results have been obtained using sawdust and even sandy loam, steam-sterilized before use. The medium must have ample pore space to accommodate the excess moisture and to permit adequate exchange of gases necessary for good root development. Washed sand of medium particle size, sand and peat mixtures, perlite or vermiculite are satisfactory with good drainage beneath.

To doubly insure good aeration of the cuttings, they should be inserted into the medium only far enough to be well anchored. A good rule of thumb is to insert the stem 1 inch or less into the bed.

Cuttings to be rooted under mist are best taken in the morning when they are full of sap. Soft, succulent shoots having one or more fully expanded leaves can be used, and fully developed leafy cuttings of nearly mature wood will also root well. Even more rapid rooting can be stimulated by using root-inducing hormones.

Mist propagation can be carried on in summer and winter in a greenhouse, or out-of-doors in summer only. In rooting cuttings under mist in open sunshine certain precautions must be taken in regions having dry air and intense sunlight. Unless the bed is protected from prevailing winds, the mist may be carried away from the bed, resulting in death to the cuttings from drying by the sun. Side protections, lath houses and plastic film have been used to prevent this. A small electric exhaust fan installed at one end of a bed enclosed with polyethylene film provides a cool, even temperature for the cuttings, with plenty of air circulating through the mist chamber. One end of the bed must remain open.

Mist for the Amateur

The mist method of propagation is used most by commercial propagators, but it can be adapted for use by the home gardener. During summer one or more mist nozzles are placed in a convenient outdoor location where drainage is adequate. The pipe supplying the nozzles can be connected to the house water supply by means of a hose. Nozzles using low pressure and delivering one to two gallons of water per hour give excellent results. The mist is turned on during the warm part of the day only.

The propagation bed can be prepared by placing 2 inches of coarse gravel or crushed stone over the selected site, which can be boxed with brick or wood. The rooting medium, as described above, is placed on this. Enclosing the bed with clear polyethylene film supported on a wire or wood frame makes it possible to keep the leaves of the cuttings moist by occasional manual operation of the water valve during the day. When the plastic film is thus used, some ventilation is necessary. An opening 1 foot square above each nozzle is sufficient for this. The film should also be at least partly shaded to prevent too high temperatures under it.

GRAFTING AND BUDDING WOODY PLANTS

Roy M. Nordine

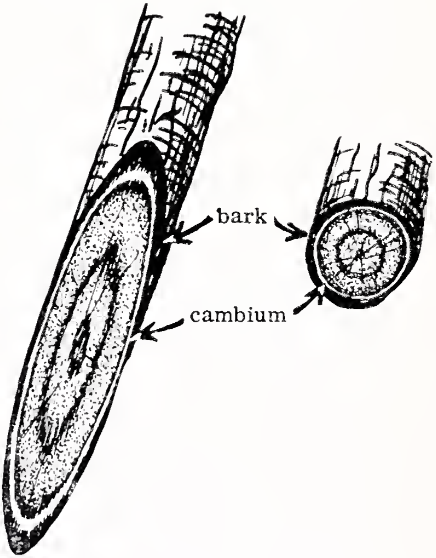
FOR the many kinds of plants that "come true from seed" propagation presents no special problem. But special techniques are necessary for those which produce no seed, or seed that cannot be relied upon to produce plants exactly like the parents. One such technique is grafting (which includes budding, also). It is the method used when other simpler means of propagation, such as stem or root cuttings, layering or division, do not produce new plants.

To the amateur it may seem a curious fact that many kinds of plants produce seeds that are unreliable — seeds which rarely, if ever, produce plants exactly like the parents from which they were taken. This may mean that the quality and appearance of the flowers, leaves, fruit and even the growth habit will be different.

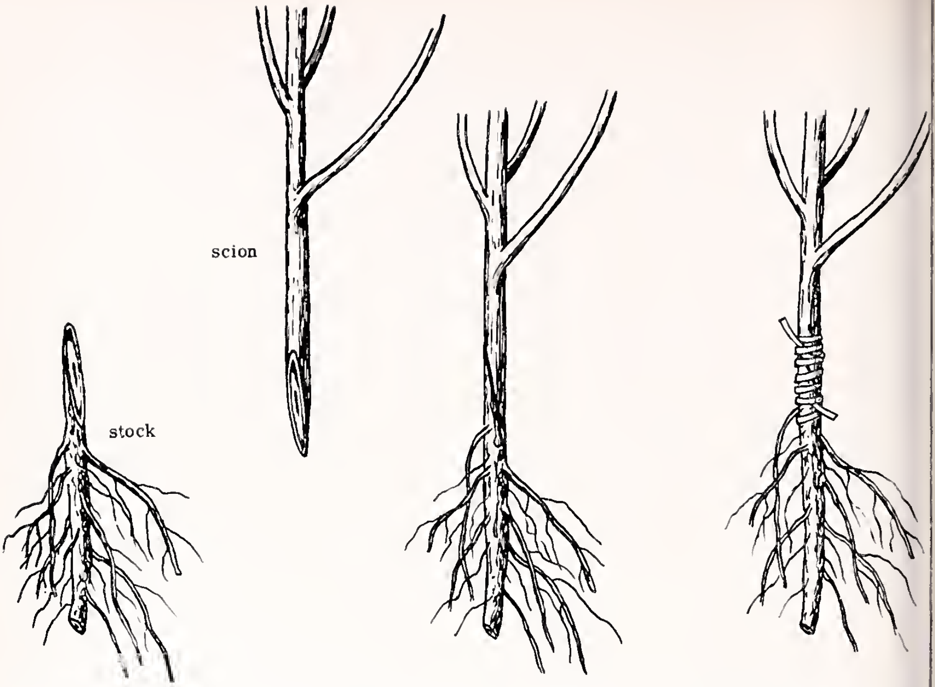
People frequently plant pits from delicious peaches and plums, and a few years later wonder why the fruit from the new trees is not even edible. One unsuspecting amateur horticulturist saved seeds from the fruit of choice flowering crab-apples, grew them to young trees, and made an extensive planting. A few years later it was discovered that no two trees were alike, the growth habit of most being unattractive, and the flowers and fruit not only ordinary, but in no way resembling the handsome parent trees from which the seeds were taken. The same would be true for virtually all of our other fruit and nut trees, and for flowering cherries, plums and almonds, most of the magnolias and nearly all the roses, tree peonies and lilacs.

So, to propagate these and many other ornamentals, including selected shade trees and conifers, the technique of grafting is used almost universally. It insures that the newly propagated plants will be like the stock from which the graft was taken.

Grafting is accomplished by uniting a small piece of twig or a single bud (in which case the technique is called budding) of the desired variety to a seedling plant that furnishes a root for the new plant. This union is possible because the actively growing tissue in the twig or bud is able to unite and heal together with similar tissue in the seedling.

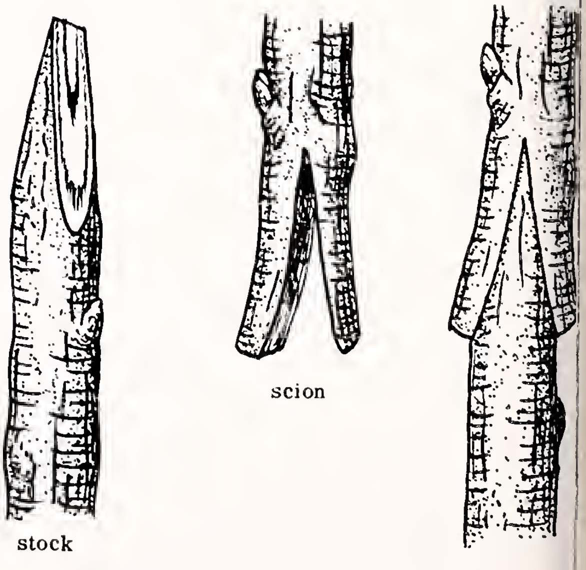


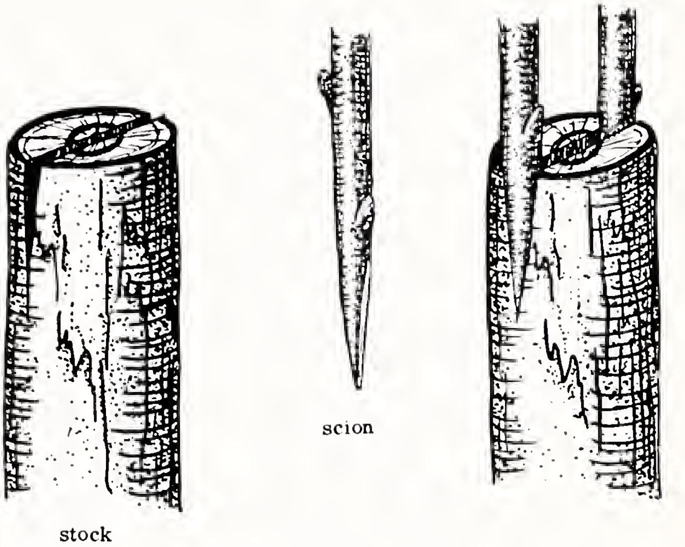
Location of actively growing layer, the cambium, just beneath bark of twig.



The splice graft is one of the simplest types of graft, used mostly with stocks and scions of the same diameter. It is most convenient for bench grafting, or for high working, not for working at ground level. Long, slanting cuts are made at base of scion and upper end of stock, the cut surfaces brought together, bound with raffia, soft string or rubber band (see captions bottom of page 151) and sealed with grafting wax.

Saddle graft. After stock and scion are fitted together they must be tied and sealed with grafting wax.





Cleft graft, used for grafting scions to stocks having considerably greater diameter. Two scions can be placed on one stock. All cut surfaces must be carefully sealed with wax after graft is made.

For the amateur it is essential that he perform all grafting operations on very closely related plants, that is, graft a rose on a rose, a crab-apple or an apple on another crab-apple, a cherry on a cherry, a plum on a plum, and so forth. (There are, however, a few plants that have a wider range of compatibility; for example, it is possible to graft lilac on privet or even on ash.)

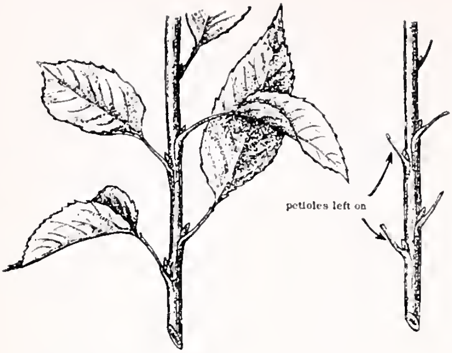
In some of the larger plant groups such as pines, oaks, maples and others, compatibility is further limited to plants that are even more closely related. For example, members of the two groups of oaks, the white and the red oaks, can be grafted only on other members of the same group.

The seedling on which grafting is performed is called the stock, understock or root-stock. In the nursery industry tremendous quantities of understock are raised by firms which specialize in this activity. This understock material, with the exception of roses, is unavailable to the amateur; therefore, he must sow seed of the desired understock and grow it until the stem at the soil line is about as thick as a lead pencil.

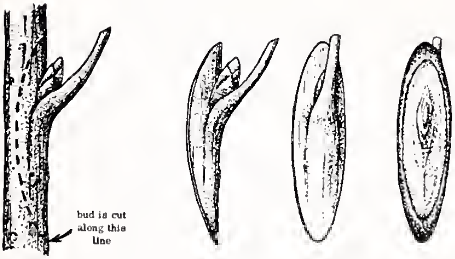
The scion [pronounced "sī′-un"—Ed.] is a portion of a twig of the desired variety that is to be grafted on the understock. It should be of the previous year's growth and about 1/4 inch in diameter. The more slender portion of the twig, that near the tip, is of no value as scion material. The important part of the scion is the dormant bud found at the base of each leaf, where the latter joins the young stem. This bud will produce a new twig the following year. In older trees it is frequently necessary to prune back a branch or two to force new growth which will provide adequate scions or buds for grafting.

The graft union between stock and scion is a physical union of the tissue, and makes possible the ready passage of sap between root and top of the grafted plant. The root generally has little influence on the top of the new plant except in cases where a dwarfing stock is used to limit top growth. New varieties cannot be created by grafting, but chimeras occasionally appear. These are explained in the footnote on page 109.

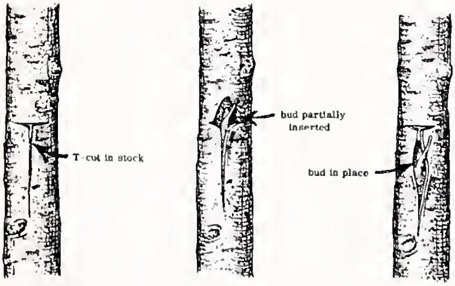
The grafting operation can be performed during the winter months, in which case it is called bench or piece grafting. It can also be done in the spring when growth of the established understock begins; in this case it is called



Suitable branch for providing buds is called a bud stick. At right blades of leaves have been removed; petioles are left to provide handle for holding buds.


bud is cut along this line

Left, shield bud enlarged, showing where it is cut from bud stick. Right, side, front, and rear views of bud.



Left, stock with T-cut for inserting shield bud. Center, bud partially inserted after bark of stock is loosened. Right, bud in place and ready for wrapping with rubber band, raffia or soft twine (see caption, bottom of page 151).

crown grafting. When grafting is performed on older trees, it is called topworking.

There are many ways of cutting the scion and understock so that they unite properly; the easiest and simplest ways are illustrated on pages 106 and 107.

Budding is a form of grafting that involves only a single bud with a small piece of bark attached. This operation is performed on seedlings planted the previous spring or on suckers or sprouts that appear around branch stubs of older trees. It can be done only when the bark separates or peels easily from the adjacent wood, usually in late July or August.

Since budding is done from late July until early September, the bud scion material (or "bud sticks") is always the current year's growth. Select buds on stems that are about the diameter of a pencil; soon after cutting the stem segments (bud sticks), remove the leaves, allowing only a short piece of the petiole (leaf stalk) to remain. This will serve as a handle in the budding operation. Place the stem segments in water or, better yet, wrap them in polyethylene film and store in a cool place until used. If refrigerated at 40°F. scion wood can be kept for several days.

A simple method of budding is shown in the illustrations. The bud is cut from the bud stick with a small "shield" of wood. A T-cut is made in the stock and the bark loosened. The shield of the bud is inserted under the bark and the bud slipped down until it fits snugly, and wrapped.

Early the following spring the stock is cut off just above the bud and the wrapping is removed. When the budded plants are to grow as shrubs, the understock is cut just above the "T"; when trees are to be grown, the understock is cut about 6 inches above the bud. This remaining stock can serve as a stake to which the growing bud is tied; then it will grow straight and not be broken the first season by wind or rain. During the first year, suckers that may be produced by the understock should be removed.

ROOTSTOCKS COMMONLY USED IN GRAFTING FRUIT TREES

Karl D. Brase

When propagating tree fruit varieties by grafting or budding it is important to know which rootstock (understock) to use for a given variety. The rootstock is capable of either stimulating the shoot growth of the variety grown upon it or it can restrict growth.*

Apple

For well known apple varieties we have a wide choice of rootstock materials. For strong growth of grafted plants, graft scions of known varieties on rootstocks of plants from seeds of such well known apple varieties as RED DELICIOUS, McINTOSH, ROME, and WINESAP.

For dwarfing effect, graft scions of known varieties on clonal rootstocks that have well known growth-restricting effects, such as MALLING 9 (gives smallest dwarfs) and MALLING 7 (gives semi-dwarfs).

Apricot

Bud scions of known varieties on the Myrobalan, or cherry plum, (*Prunus cerasifera.*) For earlier bearing, use as rootstocks plants grown from any apricot seed.

Cherry

Bud scions of known varieties of sweet or sour cherries on seedling plants of the mazzard cherry (*P. avium*). Trees will grow vigorously but will be tardy to bear fruit. Seedling plants of the perfumed cherry (*P. mahaleb*) also make good rootstocks but require well-drained soil for long life. The native species such as pin cherry (*P. pennsylvanica*) and wild black cherry (*P. serotina*) do not make satisfactory rootstocks because of poor graft affinity.

Peach and Nectarine

Bud scions of known varieties on seedlings of cultivated peach varieties. Late varieties are the best seed sources. Slightly smaller peach trees can be obtained by using seedlings of the European plum (*P. domestica*). For dwarfing effect use the Bessey cherry (*P. besseyi*) for peach varieties; where used, the budding operation must be carried out earlier in summer than when peach seedlings are used. In peach propagation budding is preferred to grafting dormant scions.

Pear

For good growth of grafted plants, graft scions of known varieties on rootstocks of plants grown from seeds of such well known pear varieties as BARTLETT, WINTER NELIS, and BEURRE HARDY.

For dwarfing effect, graft scions of known varieties on quince (*Cydonia*).

(*Please turn to page* 159)

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*The complicated relationships between scion and rootstock, and the effects they have upon one another have been intensively studied, but much remains to be understood. It is quite certain that there are no genetic effects, that is, no hybrids are produced by grafting. In fact, one of the aims of grafting is to hold a variety true to type. Occasionally a bud will arise exactly at the point of the graft union, and such a bud may have tissues derived from both scion and rootstock. Therefore some of the tissues of the resulting branch will be like those of the rootstock plant, some like the scion. The misleading term "graft hybrid" is often applied to such branches, but they are more properly called chimeras. Buds arising from graft unions are not the only way in which chimeras may be produced.

Rootstock and scion do influence one another in physiological ways, resulting in stimulating or curtailing growth. Practical use of these effects is made, for instance in using certain rootstocks for dwarfing scions grafted on them. In general, rootstocks seem to exert greater influence on scions than scions do on rootstocks.—Ed.

A UNIQUE PLASTIC WIGWAM AIDS GRAFTING

Victor J. McNitt

A WIGWAM of polyethylene plastic, which can be erected over a newly grafted plant, a tender potted plant or a seed pan, is one of the most recent aids in plant propagation. It maintains conditions favorable to plant growth, thus increasing the percentage of success. Under the wigwam the humidity is high, for when the soil water evaporates, the plastic does not permit its passage through the wigwam wall. When the water vapor inside the wigwam exceeds the saturation point of the air, it condenses on the walls, runs to the ground, is absorbed by the soil, and later evaporates again, thus completing the cycle. Gases, however, pass through the plastic readily, so the plant has the air it needs.

The wigwam, consisting of a base ring of rigid plastic, a body tube of polyethylene plastic film and a supporting stake, is shown opposite. When a plant is located in full sunlight, a square of white cloth is draped over the wigwam and secured with pins. This prevents the plant from being cooked by the heat built up inside the wigwam. During the spring at high altitudes a good grade of cheesecloth gives sufficient protection. However, in the summer, in both mountains and lowlands, sleazy muslin is advisable.

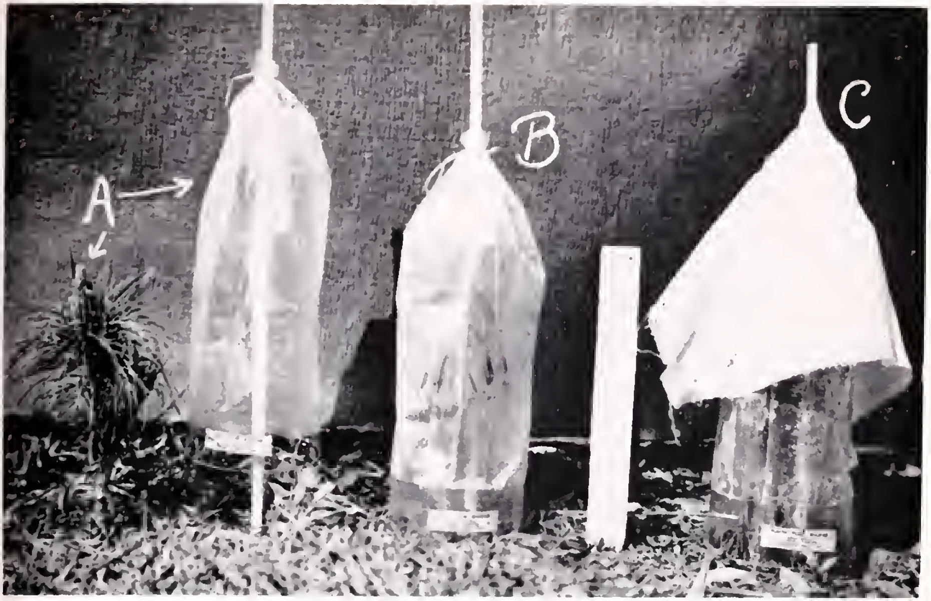
Since the plastic wigwams are used primarily for grafted plants in the open ground, they require no attention until two or three weeks after the scion becomes active. At this time part of the understock should be cut back to force the scion to faster growth. This should be done in early morning or after sundown or during a cloudy day, when the unit can be removed without harming the plant.

Also, a chip of wood or a thin stone is wedged under one side of the base ring to admit air, thus hardening the plant to outside conditions. If the species is known to be tender or particularly difficult, it would be best to raise the base of the wigwam for only an hour or two the first few days.

After following this procedure for two weeks, the top of the wigwam should be untied and then retied more loosely, gapping sufficiently to admit two fingers. The base ring should be left in a raised position. Thus the wigwam will allow movement of air but still maintain a fairly high humidity inside and protect the young graft from drying winds. On a cloudy morning the cloth shade can be removed. However, if the plant is especially tender, it might be desirable to leave the shade on.

After the top and bottom of the unit have been open for ten days, the unit can be removed entirely, and the understock can be cut back further. From this point, the new plant is on its own.

The timing of the procedure, as outlined above, is by no means inflexible. Some plants, even individuals of the same species, are much slower in response than others, so the length of each stage in the procedure must be lengthened accordingly. Then, too, some understocks are more active than others and may push growth



Photos author courtesy

A. Grafted white pine ready to be covered with plastic wigwam. B. Wigwam in place over plant. C. Wigwam shaded by piece of muslin pinned over it.

in their scions faster. Weather also is a contributing factor. If it is unusually cold when it is time to proceed to the next stage, it is better to delay until more normal weather returns. Judgment should always be based on the condition of the plant, however. If a newly grafted plant is set back on being advanced a stage, it should be returned to the previous stage until it recovers.

This wigwam technique can also be applied to tender potted plants, seed pans that must be kept moist, planted-out cuttings, newly set air-layers or any other plants that need protection and high humidity when becoming established.

Grafted pine grown under wigwam, one year after grafting.

RAISING PLANTS FROM SEED

There is no substitute for "knowing how"

Frances M. Miner

GROWING plants from seed is the most universal method of propagation. All gardeners at one time or another grow some of their plants in this way, though the techniques employed often are hit or miss — as are the results. By following a few common sense procedures, most gardeners can increase the number of kinds of plants they can raise from seed, and greatly improve their chances of success.

Saving Seed

For most gardeners, saving seeds from their own plants is hardly worth the trouble. The great majority of our present-day vegetables, annuals and perennials are hybrids of mixed ancestry that will not come true from seed collected in the home garden. Results with such seed will be very disappointing. Seeds purchased from seedsmen are grown by special techniques to insure that they will produce the kinds of plants desired. However, if one is certain that some of his home garden plants are true species, or pure lines which will come true, it is possible to save home-grown seed, or seeds of many species that grow in the wild. The seed should be collected as soon as ripe, then cleaned and stored in containers in a cool dry place until ready for planting.

Seeds purchased from reputable seedsmen are much more satisfactory, and, except for certain rare or new varieties, are very reasonable in price. Most packets contain about twice as much as is needed at one planting; the rest can be saved for the following year. Seed should not be kept over in this way for more than one year as many kinds lose their viability if kept too long. A few kinds may not even be good after one year.

When to Plant Indoors

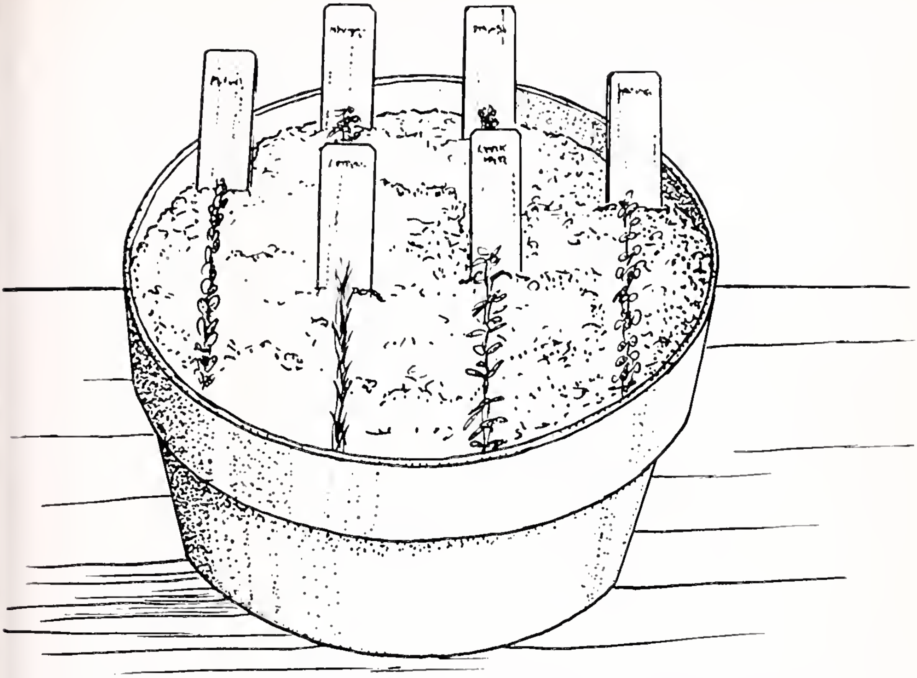
The urge to get something planted reaches a seasonal high in late winter, around January, spurred on by the arrival of new seed catalogs and articles on planting in garden magazines. As a result, many gardeners start seeds indoors too early. In warmer climates, where spring arrives early, seeds can be started at this time, but in temperate climates, as in the latitude of New York City, March is soon enough to plant indoors. Plants will then be ready for setting out-of-doors by the middle of May or a little later.

Very small seeds, or those of plants requiring a long growing season are the ones best suited to starting indoors. Seeds of fast-growing plants can be started out-of-doors when the soil is ready for planting and danger of frost is past.

Containers and Soil

Almost any kind of container that provides adequate drainage can be used. Greenhouse flats, cheese boxes, flower pots or cans with holes punched in the bottom are all good. Containers should be at least 3 inches deep, otherwise they may dry out too fast. Seeds are planted in such containers with the understanding that they are to be transplanted once, while very small, to other containers in which they will grow to a size suitable for final transplanting to the garden. This first transplanting, called pricking out, is explained below.

In the bottoms of the containers are placed pieces of broken clay pots, gravel or other coarse material to provide drain-



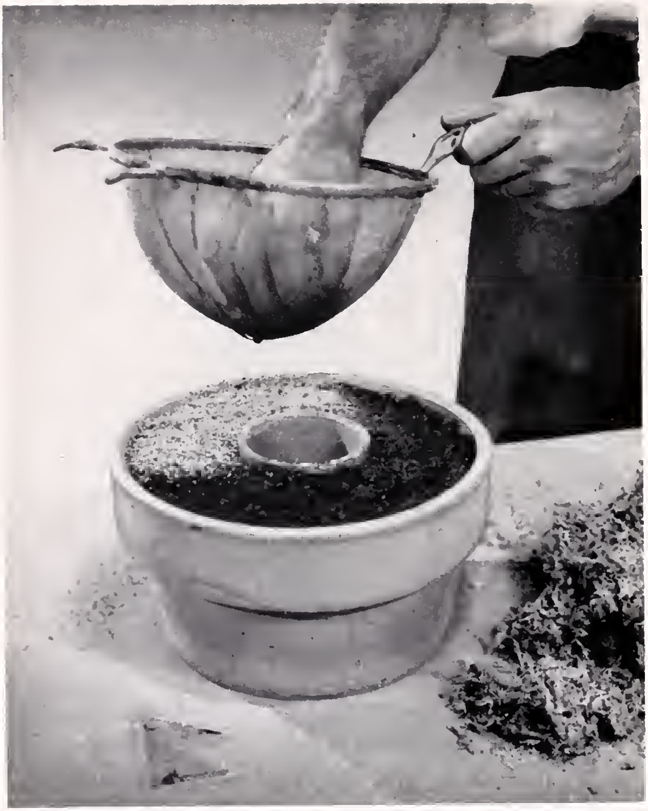
Six kinds of seeds can be planted in short rows in a single 4-inch bulb pan.

age. The container is then filled to about ½ an inch from the top with any good, light, friable soil. If available soil is rather heavy, it can be lightened by mixing in a little sand or finely ground peat moss. A common mixture that has been found satisfactory consists of equal parts sand, garden soil and leafmold.

Planting

Even in rather small containers, such as 4-inch pots, it is best to plant the seeds in rows, as this makes for easier handling when pricking out. But if desired, they can be sown all over the surface. As shown in the diagram, six short rows of seeds can be sown in one 6-inch bulb pan (shallow flower pot). All plantings should be labelled; it is easy to forget, and often hard to recognize small seedlings.

To plant the seed, make a shallow groove, the depth of which varies with the size of the seed. The best way to judge depth of planting is to take a good look at the seed and plant it about four times its diameter. For small seeds this means a very thin covering of soil indeed. Seed should not be sown too thickly as this increases the danger of death from damping-off. This is caused by a fungus that grows at or near the surface of the soil and causes the young plants to rot at that point. As a further precaution against damping-off, seed and soil can be treated with chemicals to sterilize them, but one good way to prevent it seems to be plenty of light and air and not too heavy watering. Another good preventive is the use of a light layer of finely ground sphagnum moss on top of the soil.



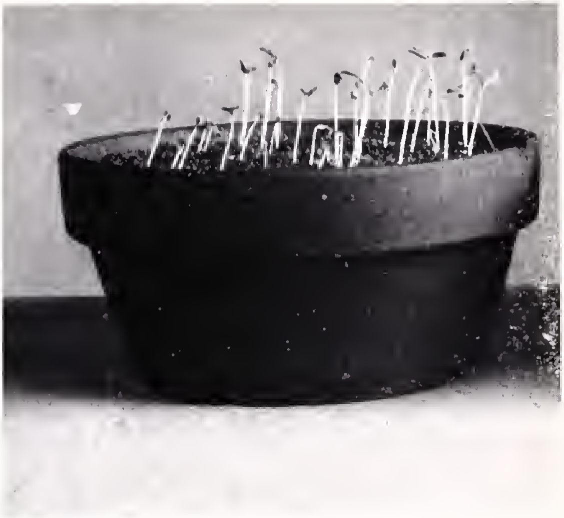
Roche

Thin layer of sifted sphagnum on top of soil checks the damping-off disease caused by fungi. Small pot in center, its drainage hole closed by a cork, forms reservoir, helps provide more uniform moisture.

Watering from below by setting pots in pan of water.

Buhle

Seedlings should be given full light as soon as they sprout. Seedlings in this pot received insufficient light and as a result are pale and spindling.



Watering

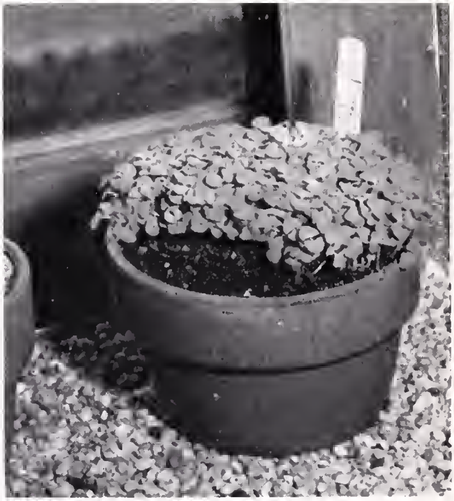
Watering is one of the chief reasons for success or failure with seedlings. The soil should be moist but not wet at the time the seeds are planted, and it should be kept as nearly as possible in this state at all times from planting on. Small seedlings dry out very quickly — and once is often fatal. On the other hand roots must have air as well as water, and if the soil is kept soaked for very long the plants literally drown. There is no set rule as to times for watering — the condition of the soil determines whether to water or not. On bright warm days plantings may have to be watered two or three times, on dark damp days not at all.

As soon as the first seedlings appear in a pot it should be set where it will get bright sunshine. This is a point overlooked by many gardeners but it is necessary to insure the growth of good sturdy seedlings. If it is not done, the seedlings grow long and spindling, a state of affairs almost every gardener has encountered. Of course, extra care must be taken to see that the seedlings do not get too dry.

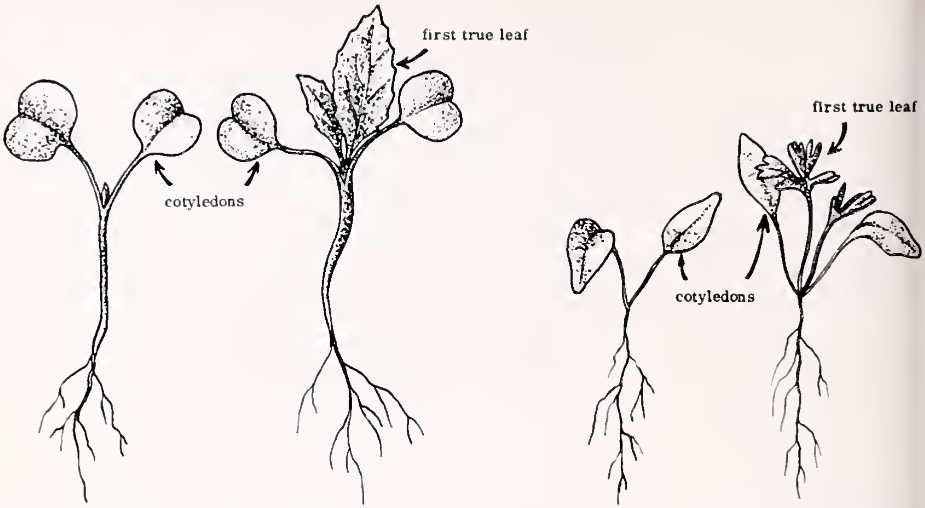
Pricking Out

As shown on the next page, most seedlings when first up show two small "seed leaves." These are followed in due time by the first true leaves, which are characteristic of the plant. When these

Buhle photos

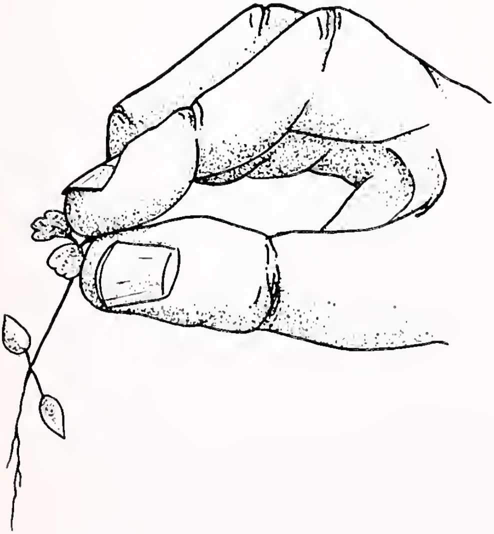


These seedlings received plenty of light and are green and sturdy.



The first leaves which appear on many seedlings are the so-called seed leaves (cotyledons) which often bear no resemblance to the later leaves. When the first true leaves, which are more or less typical of the later leaves, appear the seedlings can be pricked out.

first true leaves are visible is the best time for pricking out. This transplanting operation checks the growth of the seedlings temporarily, making them grow into more compact plants. The seedlings are lifted a few at a time from the starting containers with a pencil or small flat stick (a pot label is good) and planted one by one in larger containers. To handle without damaging, the tiny plants should be held by a leaf (not the stem) between thumb and forefinger. Holes of appropriate depth and about 2 inches apart are made in the soil of the new containers and the seedlings inserted in these. Roots should not be exposed to the air any longer than is necessary. After a seedling is inserted in a hole, the soil should be well but gently firmed about the roots, leaving the surface soil loose.

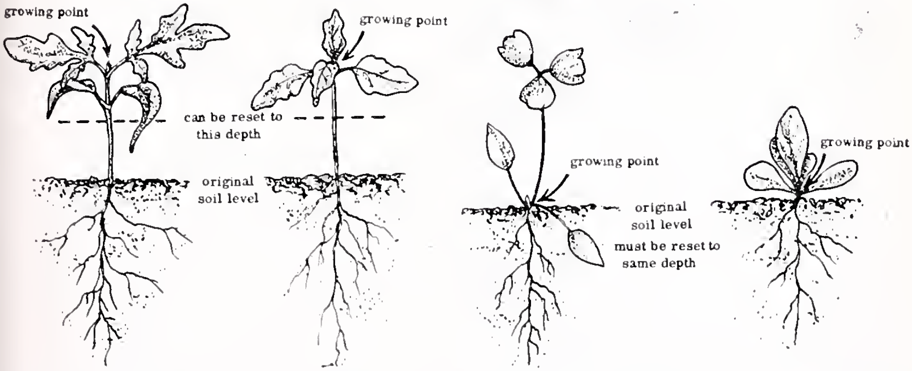


When seedlings are being pricked out they should be grasped by a leaf, as shown, not by the stem.

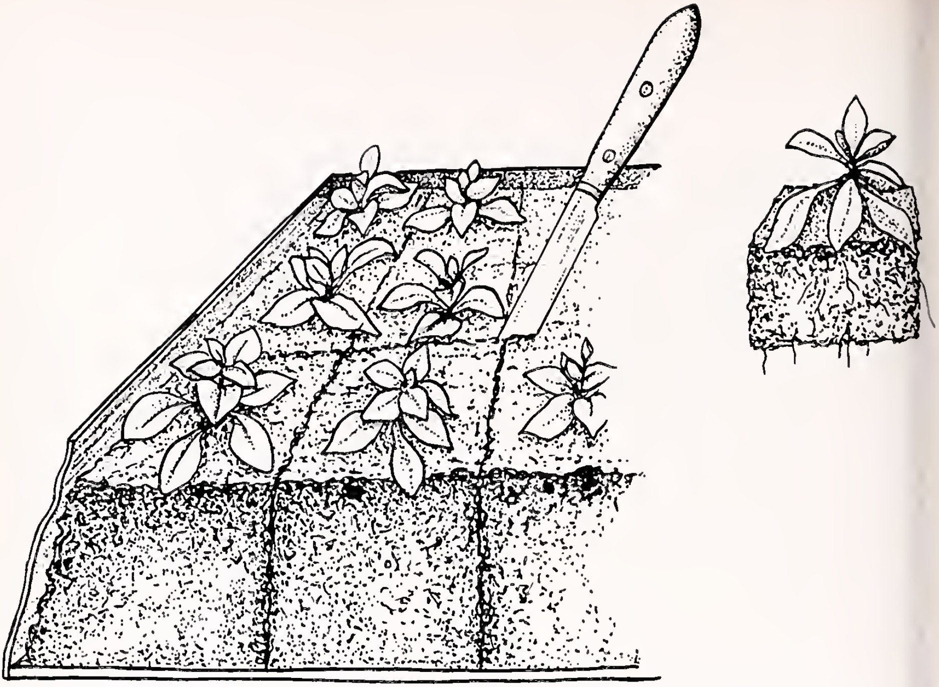
Seedlings are of two types — those forming a rosette, with the growing point at the base of the cluster of leaves, and those with an upright stem having the growing point at the tip (see illustration). The first must be pricked out exactly the same depth they were growing in the starting containers. If they are planted deeper than this, the growing points are buried and the seedlings may die. The other type may be pricked out to the first leaves; the growing points are at the tops of the stem and will not be buried.

Roche

Pricking out seedlings from can to greenhouse flat. These seedlings could well have been pricked out at an earlier stage.



The growing points of some seedlings, such as tomato and clarkia (left), are at the tips of the upright stems. When pricked out, such seedlings can be planted deeper than they were originally growing; additional roots will come out along the stem wherever it is under the soil. Growing points of other seedlings, such as columbine and petunia (right), are at the centers of rosettes of leaves, at the soil line. Such seedlings must be replanted to the same depth as they were originally growing so as not to bury the growing point.



When seedlings which have been pricked out into flats are ready for transplanting to garden, the soil in the flat can be cut like a cake, and each plant removed with a block of soil around its roots.

Roche

Sowing seed in trench in garden. When seedlings appear they can be thinned out to proper spacing.

When the time for final transplanting to the garden has arrived, the soil in which the seedlings are growing can be cut like a cake, with a block of soil around each plant, and the plants lifted and set in their permanent places.

Hints on Planting Out-of-doors

Seeds to be planted directly in the garden can be put in rows and then thinned out, but a more economical method is to plant two or three seeds at each point along the row where a plant is wanted. When the seedlings are up the extra plants can be pulled out, leaving the sturdiest. Depth of planting again is the most important point in outdoor seed sowing. Fine seeds are sprinkled on the surface and raked; slightly larger ones are covered by ¼ inch of fine soil; and those the size of radish or zinnia can sprout through an inch of cover.

GROWING TREES AND SHRUBS FROM SEED

Lewis F. Lipp

TREES and shrubs may be propagated in various ways. Nature's methods of perpetuating a species through seeds and layering are natural means and the remaining artificial methods are the use of cuttings, grafting and bud-grafting. Hybrids rarely if ever come true from seed, and for this reason are propagated vegetatively. Also, trees and shrubs reach flowering size sooner when propagated vegetatively than when grown from seed. Trees, when raised from seed, are in most cases more healthy and they are more apt to live longer than a plant grown from a graft.

Before discussing the various kinds of seed and their treatments, I wish to point out that, to promote favorable growth of the seedlings, the original environment of the parent plant should be re-created as closely as possible.

Following is a classification of seeds and brief directions on handling each type:

Fleshy seeds, such as oak (*Quercus*), chestnut (*Castanea*) and horse-chestnut and buckeye (*Aesculus*). The majority of these seeds break dormancy rapidly and should be sown soon after harvesting. If this is impractical, distribute seeds in moist sand and store out-of-doors in a container over the winter months; in early spring plant in drills. There are exceptions, as in the case of white oak, which should be sown immediately; the acorns germinate shortly after harvesting.

Hard-coated seeds, such as viburnum, holly (*Ilex*), dove-tree (*Davidia*), cotoneaster and plum, apricot, cherry and peach (*Prunus*). Pick the shriveled, ripe fruits and put to soak for perhaps several days in water. As the old fruit flesh decomposes, run the fermenting mass through the fingers; this will help separate seed from pulp, and will permit the pulp and non-viable seed to rise to the surface, while the viable seed will go to the bottom of the container. A stream of water from a garden hose placed a few inches below the surface of the water will float away the pulp mixture, leaving the cleaned seed. In some instances seeds of these species germinate in spring after a period of low temperatures. With these

Buhle

Separating seed from fruit. Left in water for a few days fruits become soft and seeds can be squeezed out from pulp by hand.

Photo author courtesy

Rhododendron seedlings growing on sphagnum in flat.

the natural process can be imitated by sowing the cleaned seed in the fall in a drill and lightly covering with soil. Placing a wire screen over the planting will protect the seeds from rodents and birds. In the spring the seedlings of some of the fast-growing species may be transplanted 10 to 12 inches apart in a nursery row.

Note that in some of the species of cotoneaster, hawthorn (*Crataegus*), holly and viburnum the seeds have a double dormancy; also, the degree of dormancy varies from crop to crop. To hasten germination the seed may be scarified or treated with sulfuric acid. However, while these methods hasten germination, they also result in fewer seedlings. Therefore, it is recommended that the cleaned seeds be sown in the fall. While a few seeds will germinate the following spring, most will germinate the second spring. Germination of seed having double dormancy can be speeded by the following practice: place the seeds in moist peat, sawdust or sand in a polyethylene freezer bag. Tightly seal, label and store at room temperature for approximately 120 days. Then place in the refrigerator at 34° to 40°F. for another 120 days.

Winged seeds, such as fir (*Abies*), spruce (*Picea*), pine (*Pinus*) and maple (*Acer*). Maple seeds, after they fall to the ground, appear to require a moist mulch for germination, for if the moisture content is reduced germination is delayed. For this reason summer-ripening species, such as red maple (*Acer rubrum*), can be sown soon after collecting. Sugar maple seeds (*Acer saccharum*), which ripen in the fall, require a period of cold before germinating. Dormancy in some species, such as the unusual paperbark maple (*A. griseum*), can be overcome somewhat by gathering seeds before they are fully ripe and stratifying at once.

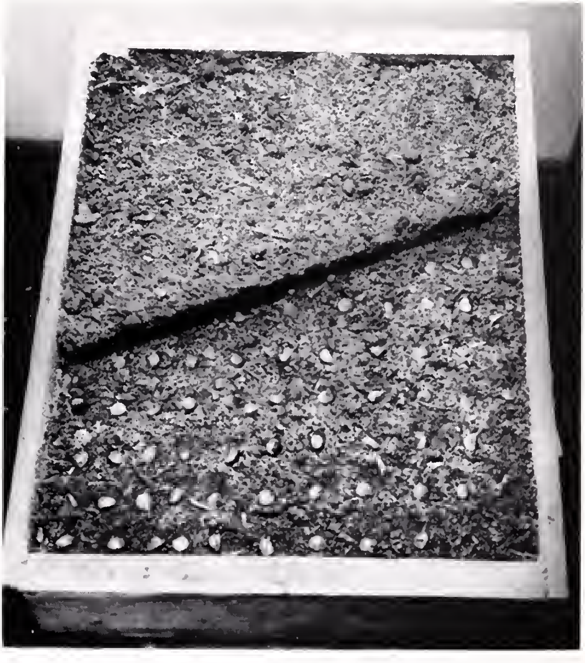
Cones of fir, spruce, pine and other conifers are usually picked from the tree just as they open. The seeds will be shed as the cone scales open. The wings of these seeds are removed and the seed is then stored until spring at 34° to 41°F. in moist peat, sawdust or sand. It is then broadcast on well-drained, sandy loam soil. During the first growing season the seedlings should be lightly shaded and mulched with a thin layer of pine needles. Experience has proved that a pre-treatment of cold stratification improves germination of most conifers.

Very fine seed, such as rhododendron, azalea, kalmia and pieris. During early fall the dehiscent seed capsules of rhododendrons and azaleas often go unnoticed. These capsules disperse their powdery seeds over a considerable area and often the amateur collector is too late to harvest them. The ideal time to collect these fine seeds is when they have turned dark brown and are still in the capsule. They can be placed in a paper bag and stored in a cool, dry place until late April. To prepare the seed flat for sowing, fill it with sieved, moist peat moss, and level. Distribute the fine seed lightly over the moist peat moss. Do not cover the seed with peat moss; water with a fine mist. Place a sheet of plastic film over the flat and set it where the temperature is about 70°F. When the seedlings begin to appear, remove the plastic and keep the flat moist. Provide sufficient light and air. The young seedlings can be transplanted into a mixture of 40 per cent Michigan peat, 40 per cent imported peat moss and 20 per cent sand. The use of this mixture for ericaceous plants (rhododendrons, azaleas, pieris and others) reduces weeding to a minimum and obviates the use of chemical treatments to control damping-off. Seedlings that are eight months old can be transplanted to a cold frame for the winter or to a raised bed. They can be expected to flower the third year provided they have been properly protected through the winter months. A mulch of pine needles or corncobs is beneficial.

Spirea, hypericum and hydrangea also fall into the fine-seed classification and require the same technique in sowing. However, the seedlings should be transplanted into a sandy soil instead of into the peat moss mixture, as recommended for ericaceous plants.

Raising trees and shrubs from seed requires patience and a great deal of time, yet will give considerable pleasure to all who enjoy turning up the unexpected in raising plants from seed.

Buhle



Stratified magnolia seeds planted in flat; partially uncovered to show spacing and depth of planting.

WOODY PLANT SEEDS WHICH SHOULD BE STRATIFIED

Stratification is the storing of seeds for a period of after-ripening in a moist medium at a low temperature, usually a little above freezing. Seeds were formerly always stratified in layers, hence the term stratify, but now they are most often mixed with the medium.

For details see page 124.

Stratify at 41° to 45°F. which is about the temperature range of the average home refrigerator.

Common Name	**Scientific Name**	**Approximate Time to Stratify (Days)**
Fir	*Abies spp.*	60 - 90
Red Japanese maple	*Acer palmatum*	100 - 120
Norway maple	*Acer platanoides*	90 - 120
Horse-chestnut	*Aesculus* spp.	120
Shadbush	*Amelanchier* spp.	90 - 180
Papaw	*Asimina triloba*	100
Barberry	*Berberis* spp.	15 - 40
Hornbeam	*Carpinus* spp.	100 - 120
Bittersweet	*Celastrus* spp.	90
Hackberry	*Celtis* spp.	60 - 90
Fringe-tree	*Chionanthus virginicus*	90 - 120
Yellow-wood	*Cladrastis lutea*	90
Flowering dogwood	*Cornus florida*	100 - 130
Kousa dogwood	*Cornus kousa*	120
Persimmon	*Diospyros virginiana*	60 - 90
Russian-olive	*Elaeagnus angustifolia*	90
Beech	*Fagus* spp.	90
Ash	*Fraxinus* spp.	30 - 90
Juniper	*Juniperus* spp.	90 - 120
Privet	*Ligustrum* spp.	60 - 90
Sweetgum	*Liquidambar styraciflua*	30 - 60
Tulip-tree	*Liriodendron tulipifera*	70
Honeysuckle	*Lonicera* spp.	30 - 60
Magnolia	*Magnolia* spp.	120 - 180
Apple	*Malus* spp.	30 - 90
White spruce	*Picea glauca*	60 - 90
Blue spruce	*Picea pungens*	30 - 90
Pine	*Pinus* spp.	30 - 90
Apricot, Cherry, Peach, Plum	*Prunus* spp.	60 - 120
Rose	*Rosa* spp. and hybrids	120 or more
Mountain-ash	*Sorbus* spp.	60 - 120
Chaste-tree	*Vitex agnus-castus*	90

Some seeds are benefitted by being stratified for a time at a high temperature before being given the cold treatment. The following are among these.

Common Name	**Scientific Name**	**Warm: Temp. in degrees F.**	**Days**	**Cold: Temp. in degrees F.**	**Days**
Cotoneaster	*Cotoneaster* spp.	58 to 77	90 to 120	33 to 41	90 to 120
Hawthorn	*Crataegus* spp.	77	120	41	180
Silverbell	*Halesia* spp.	68	30 to 90	41	60 to 90
Spicebush	*Lindera benzoin*	77	15 to 30	34 to 41	90 to 120
Jetbead	*Rhodotypos scandens*	86	30	41	90
Yew	*Taxus* spp.	68	90	41	120
Linden	*Tilia* spp.	68	120	41	90 to 150
European Cranberry-bush	*Viburnum opulus*	68 to 86	60 to 90	41	30 to 60
American Cranberry-bush	*Viburnum trilobum*	68 to 86	90 to 150	41	60

DIFFICULT SEEDS

How they can be germinated

Fred C. Galle

THE propagation of plants by seed is the most widely used method, but gardeners sometimes encounter difficulties and failures which they do not understand.

Fortunately, most of the plants grown from seed are annuals and other plants which germinate readily and under a wide variety of conditions. Simple methods are sufficient for these (see page 112). However, these simple germination practices often do not work with perennial seeds, and with seeds of many woody plants. A brief discussion of the factors involved may be helpful.

Seed Dormancy

The term dormancy is applied to the inability of a seed to germinate. Dormancy may be due to unfavorable environmental conditions, or to factors within the seed itself. Some of the environmental factors which influence germination are moisture, temperature, oxygen and, in a few cases, light. These factors must be in proper balance for all seed germination—of easy seeds as well as of difficult ones. Water and oxygen are of course necessary for all growth, and little need be said about these.

Effect of Temperature and Light

Some seeds have peculiar temperature requirements. While most germinate over a rather wide range of temperatures, others are somewhat more particular. Optimum temperatures for germination of some of these seeds are given on page 125.

Likewise, most seeds will germinate in either light or darkness, but a few require light in order to germinate, while others are inhibited by it.

Hard Seed Coats

Internal dormancy is not often considered by gardeners and may be the cause of apparent failure in growing plants from seed. One of the commonest causes of internal dormancy is a hard seed coat. A seed coat is a protective agent for a seed, but it can also prevent germination by keeping out water and air, and even by restricting the embryo from expanding and growing. In many cases the effect of the hard seed coat can be overcome by cracking the seed coat (being careful not to crush the contents), or by nicking it with a knife or file. Usually it is necessary only to make a small break in the coat to overcome the dormancy. Other methods are to soak the seeds in nearly boiling water or in concentrated acids. These soften the coats enough to enable water and air to penetrate. They are not recommended for the amateur because the times of soaking are often quite critical and too long soaking can easily kill the seeds. And handling concentrated acid involves, of course, a certain risk to the operator.

Other Types of Dormancy

The food storage tissue (endosperm) in some seeds acts very nearly like a hard seed coat; this type of dormancy can usually be overcome in the same way.

In some seeds the immature plant (embryo) itself is not completely organized at the time the seed is shed. In most such cases not much can be done to speed up germination. For example, ginkgo and English and American hollies will germinate only after the embryo has had an opportunity to mature at favorable temperatures and humidity. This may take as long as two or three years.

Heavy seed coats such as those of *Camellia sasanqua* seeds (center) can be carefully cracked with a nutcracker or nicked with a knife.

The causes of dormancy in many seeds are not so obvious as it is in the types just discussed. These seeds are said to require a period of after-ripening before they will germinate. No doubt certain chemical and physical changes take place during after-ripening, but little is known of their exact nature. The home gardener need not be concerned with this beyond knowing that after-ripening can often be brought about or speeded up by subjecting the seeds to low temperatures for certain periods of time. This cold treatment is called stratification. Seeds can be stratified in damp sand, shredded sphagnum, peat moss, or a mixture of peat

Many seeds need to be kept cold and moist for a period of after-ripening before they will germinate. This cold treatment is easily accomplished by mixing clean seeds with moist peat moss, wrapping in plastic, and placing in refrigerator. Label for bag should mention type of seed, date collected, and date placed in refrigerator.

Photos author courtesy

moss and sand. The medium must be moist, but never saturated. The seeds may be placed in layers in the stratifying medium or may be mixed with it. If they are very small, it may be advisable to fold them in a piece of cheesecloth before stratifying. Containers may be greenhouse flats, glass jars or plastic bags. Jars and bags are most convenient for the amateur, as they can be easily stored in a refrigerator. Jars should have covers to prevent drying out of the seeds, but they should not fit so tightly as to exclude air. With the plastic bags there is no problem. Stratified seeds should be kept at about 40° F., but in most cases a variation of 4° or 5° is not serious. Actual freezing does not help the after-ripening process except in a few cases. It is well to examine the seeds from time to time after they have been in stratification and as soon as any show signs of germinating all should be removed from the cold and planted.

Fringe-tree, many viburnums, and peonies have a type of dormancy called epicotyl or shoot dormancy. The seeds germinate and roots appear after a warm treatment, but the shoots fail to develop until they have been exposed to a temperature of about 40° F. for several months. In other seeds there is a combination of factors inhibiting germination, and dormancy can be overcome only by combined treatments.

Seeds Having Special Requirements for Germination

Germination of many seeds is delayed because they have hard seed coats; the condition is particularly common among members of the legume family. The following are a few of the woody plants having such seed coats:

Camellia
Siberian peashrub (*Caragana arborescens*)
Redbud (*Cercis canadensis*)
Yellow-wood (*Cladrastis lutea*)
Flowering dogwood (*Cornus florida*)
Cotoneaster
Red haw (*Crataegus mollis*)
Honey locust (*Gleditisia triacanthos*)
Golden rain tree (*Koelreuteria paniculata*)
Tree peony (*Paeonia suffruticosa*)
Black locust (*Robinia pseudoacacia*)
Meadow rose (*Rosa blanda*)

Other seeds require surprisingly low temperatures, not just for after-ripening, but for germination. For example:

annual delphinium germinates best below 68°F.
pansy (*Viola tricolor*) will not germinate above 70°F.
bitter-root (*Lewisia rediviva*) germinates only below 50°F.
Mariposa lily (*Calochortus macrocarpus*) germinates only below 41°F.
Tatarian honeysuckle (*Lonicera tatarica*) and American columbine (*Aquilegia canadensis*) germinate best in temperatures alternating from 50° to 77°F.

Most seeds germinate equally well in light or darkness, but some are stimulated by light.

Stimulated by light:
  Draba aizoides
  Gentiana septemfida
  common monkey-flower (*Mimulus guttatus*)
  Himalayan primrose (*Primula denticulata*)
  trailing arbutus (*Epigaea repens*)
Require light:
  top primrose (*Primula obconica*)
  rosette ramonda (*Ramonda pyrenaica*)
  meadow salvia (*Salvia pratensis*)

LAYERING

An almost foolproof method of vegetable propagation

John P. Mahlstede

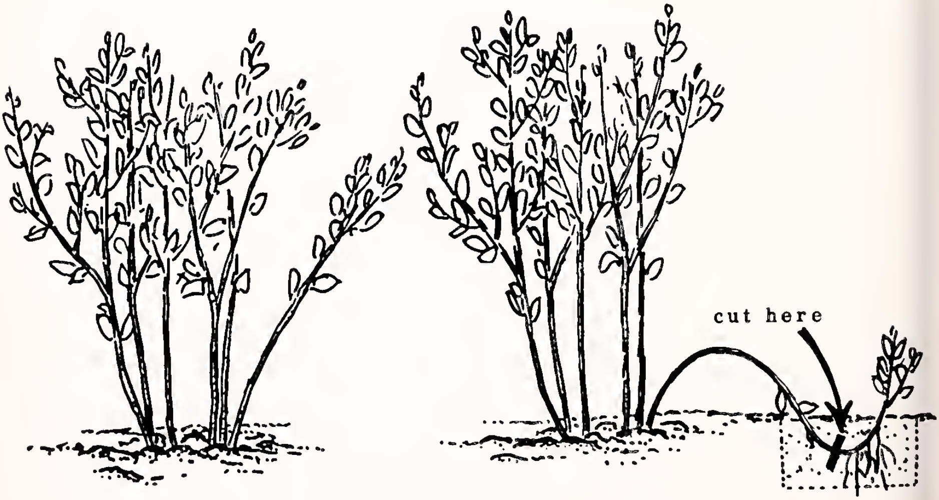
LAYERING is the technique of rooting shoots while they are still attached to the parent plant. It differs from propagation by means of cuttings chiefly in that the "cutting" is not detached from the parent until after it has rooted. Layering is not so demanding as many other vegetative methods of propagation, and if properly carried out is almost certain of success. It is one of the oldest propagating practices, and the art can be traced back to ancient China. In its most simple forms it is a natural method of reproduction for many plants. It can be observed on any tramp through the woods—prostrate branches become covered with soil or leaf mold, send out roots and shoots and form new plants.

Layering is used to propagate plants that do not come true from seed and that cannot be grafted or budded easily, that fail to sucker, or are difficult to root as cuttings. In its various forms it is a rather cumbersome method of increasing plants and therefore not so desirable as some others when quantity production is wanted. For the amateur who wants to increase only a few plants, it is a very good method and even commercially it is used for some plants such as black raspberry and dewberry.

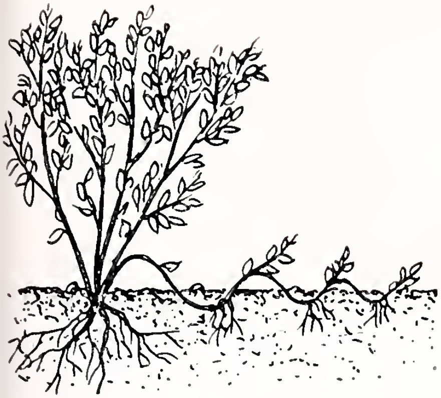
The various methods of layering are illustrated in the drawings. For the home gardener, interested in propagating only a few plants, the air layer and the common or simple layer are the two most useful methods. Air layering is discussed on pages 99 to 101.

Simple Layering

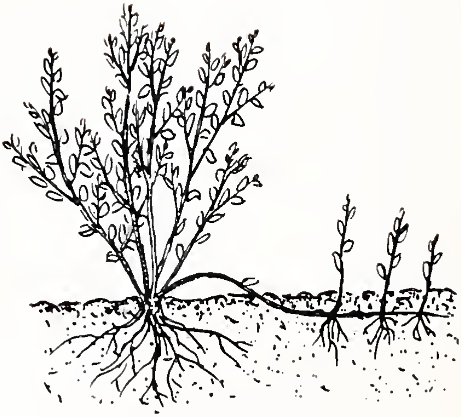
Simple layering is accomplished by bending a branch of a plant to the ground



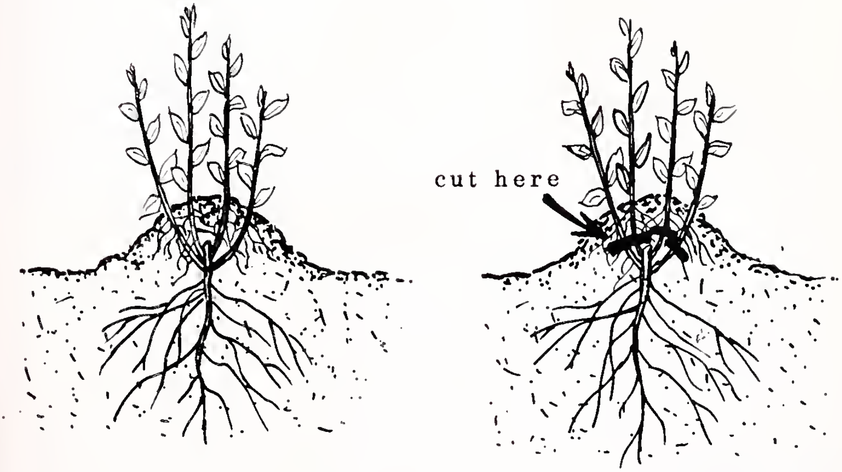
Simple Layering



Compound Layer

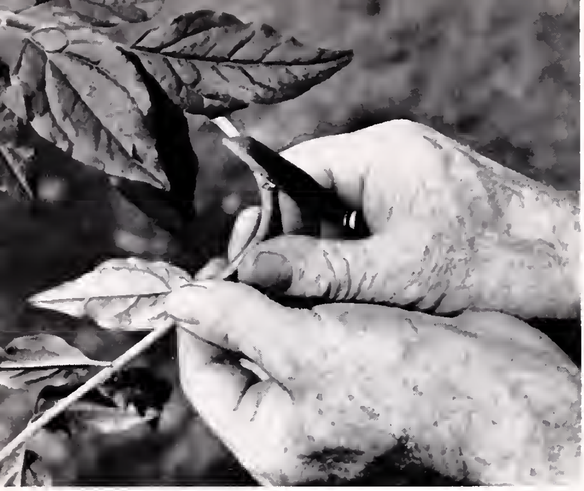


Continuous Layer



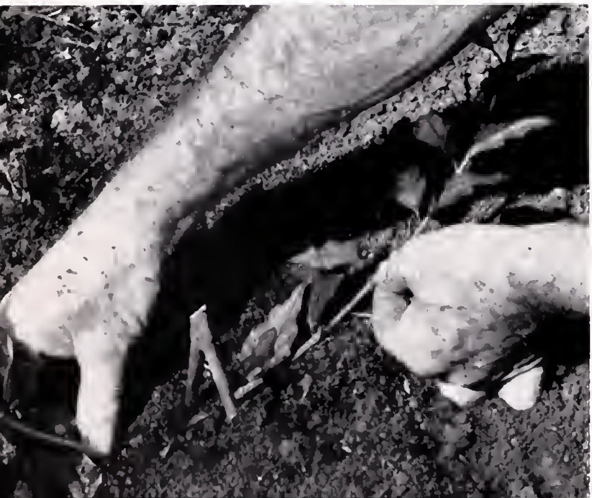
Redrawn from author

Mound or Stool Layer
Shrub is cut back to induce formation of suckers
which root when mounded with earth.



Making incision in branch befor layering. Care must be exercise not to cut clear through branc

Branch with incision is laid on prepared soil.

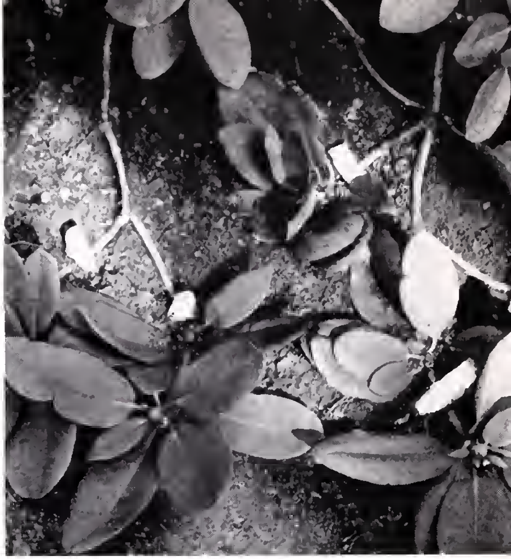


Section of branch where cut was made is covered with soil. Forked stick (U-shaped piece of wire can be used) holds it in place. Rooting will occur around incision.

and covering a portion of it about 5 to 10 inches from the tip with a light soil mixture. It is advisable that the soil around the parent plant be prepared before layering by working in sand, peat moss, or some other material to lighten and condition the soil. It is essential that the medium in which the layer is to be rooted be well drained and aerated, yet have a good capacity for holding moisture.

Before covering the branch with soil, it may be girdled by removing a ring of bark about 1 inch wide from the portion that is to be covered. Or, it may be wounded by making a knife cut about half through the stem on the lower surface. If the branch or cane is particularly delicate it may be advisable to make the wound or knife cut on the upper surface of the stem, twisting it as the layer is placed in the soil. Wounding in these ways tends to hasten rooting. It may be further speeded up by treating the wound with a root-inducing hormone powder. To hold the layer in place in the soil it may be necessary to peg it with U-shaped pieces of heavy wire or forked branches as shown in the illustrations.

Simple layering may be done early in the spring, using still dormant wood produced during the previous growing season, or in late summer, using current season's growth which has not yet become woody or hardened. A very great number of plants can be propagated by this method; those which produce numerous low, flexible branches near the edge of the clump are particularly adapted to it.



Roche photos

Layering rhododendron. Branches (with incisions made as shown on opposite page) pegged to ground by forked sticks.

The rapidity with which layered shoots root varies with the kind of plant, age of the shoot, and conditions that prevail during the rooting period. Easily rooted plants will be established by early fall, and can then be separated from the parent plant, transplanted with a ball of soil, cut back, shaded and watered. Where winters are severe it may be advisable to leave the rooted layer attached to the parent plant until early spring, when it can be separated and transplanted either bare-rooted or with a ball of soil. For some slow-rooting plants such as magnolia and most evergreens, it may be necessary to leave the layer attached to the parent for as long as two or three growing seasons before a root system large enough to support the new plant is produced.

Covering sections of layered branches with peat moss mulch.

HOW TO PROPAGATE GARDEN PERENNIALS

The amateur can readily increase his own stock

William I. P. Campbell

HERBACEOUS perennials, the dependable border plants that keep our gardens colorful year after year, coming up from the same root system with persistent regularity and a minimum of care, can be propagated in several ways. Some can be grown from seeds; others from stem, root or, in a few cases, leaf cuttings; still others by dividing, layering or grafting the plants.

Propagating by Seeds

Only those perennials which are true species can be grown satisfactorily from seed. Most modern varieties are hybrids having mixed parentage and therefore they do not come true from seed (see page 000). The popular biennials, Canterbury bells (*Campanula medium*), foxglove (*Digitalis spp.*), sweet William (*Dianthus barbatus*), and pansy (*Viola tricolor*), are also grown from seed.

Collecting ripe hollyhock seeds.

Gantner

If seed is being gathered from one's own plants it should be collected as soon as ripe, cleaned and sown. Seed of most perennials can also be purchased. Seed that does not ripen until late in the season can be collected and stored in containers in a cool dry place over winter, and then sown in spring. The length of life (viability) of seeds varies greatly. Some, such as delphinium, gerbera, regal lily, flax, thalictrum and viola, are short-lived, and are not dependable if they are kept more than a year unless stored in airtight containers. Many other perennial seeds retain their viability for as long as five years.

Some perennial seeds, such as those of dictamnus and certain rose species, germinate sooner and better if first stratified. This is done by mixing the seed with moist peat, sand or vermiculite and placing it in a refrigerator at a temperature of 35° to 45° F. for about two months. After this treatment it is sown. Do not discard seed if it does not germinate immediately; some perennials, especially certain of the alpines, may take a year or more to germinate.

If a cold frame is available, seed can be sown in rows in the soil in the frame after it has been forked over, firmed and smoothed. Merely press very fine seed into the soil, but if it is larger, cover it with soil to a depth three or four times its diameter. After sowing moisten with a gentle spray and shade from the sun.

When no cold frame is available, or when handling small lots of seeds, sow in bulb pans (shallow flower pots) or wooden flats. Propagating units made with plastic film (page 97) or plastic refrigerator boxes can also be used successfully.

To prevent damping-off of seedlings, caused by fungi, the soil can be treated with a fungicide before sowing the seed. Other control measures include sterilizing the soil with steam or hot water, or sowing the seed in sterile vermiculite, sand or neutral peat.

After germination the seedlings should be given plenty of light and air. In the cold frame they should be thinned out after they have formed their first true leaves. If they were germinated in pots, flats or other small containers they can be transplanted (pricked out) at this time to more roomy quarters in other flats or in individual pots.

A few perennials, such as platycodon and lychnis, will bloom the first season if sown early, but most will not bloom until the second season.

Dividing Perennials

Many perennials lend themselves to division, a method many home owners use successfully to increase their stocks. To keep these perennials vigorous, they should be divided periodically, discarding the older center growth and replanting only the strong growth from the outer edge of the clump. An easy way to divide a plant is to lift it, then insert two spading forks back to back into the clump (see page 133) and bring the fork handles together, prying the clump apart. This technique reduces the danger of damaging too many of the roots.

Divisions can be made at various times of the year, but a good rule to follow is to divide fall-flowering plants in the spring, and spring-flowering plants in the fall. Some perennials — chrysanthemums are an example—should be divided every year; others, among which are helenium, aster, monarda and oenothera, every two or three years. Many, such as phlox, iris, hemerocallis, physostegia and astilbe, should be divided only every three or four years. Finally, there are some that do not take kindly to being disturbed and so should be left alone unless the plant becomes weak and flowers sparsely; these include peony,

Roche

Cold frame is very helpful in raising seedlings. Frame shown here contains flats of pansy seedlings.

Two pots of perennial seedlings and cuttings to be rooted in pot covered with polyethylene film.

Author Courtesy

Propagating by division. First step is to remove topsoil from around plant.

Gantner photos

Plant is carefully lifted with fork.

gas plant (*Dictamnus*), bleeding-heart (*Dicentra*), Oriental poppy (*Papaver orientale*), lupine (*Lupinus polyphyllus*) and Christmas-rose (*Helleborus niger*).

Rooting Cuttings

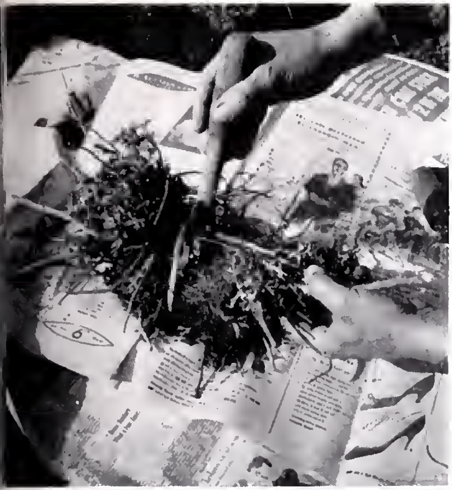
Propagation by cuttings is a method used extensively by commercial growers to increase stocks of plants that will not come true from seed. For the amateur it is generally more satisfactory to obtain more plants by dividing than by resorting to cuttings, except for plants that do not spread readily enough to permit frequent division, or those that grow extremely easily from cuttings.

Stem cuttings are most frequently used. To make them, young shoots 1 to 3 inches long are taken from the stock plant, making a clean cut just below a node, where a leaf joins the stem. Usually the larger leaves are removed or trimmed. The base of the cutting can be treated with one of the root-promoting hormones, following manufacturer's directions. The cuttings are then inserted about one third their length in a moist rooting medium such as sand, vermiculite or perlite. After insertion of the cuttings, the medium should be pressed firmly around them. The cuttings may be kept out-of-doors in a shady, sheltered spot where they can be easily kept moist; they may be placed in a Lipp propagating unit (see page 97); or they may be rooted in a bulb pan encased in polyethylene film. A new technique for rooting cuttings of many kinds of plants with the aid of mist is discussed on page 102.

Some popular perennials are more easily increased by root cuttings than by stem cuttings. To make these cuttings, a few large, strong roots are removed from the plant (it may be necessary to lift the plant to do this) and cut into pieces 1 to 2 inches long. The pieces are laid horizontally in sandy soil and covered to a depth of about 1 inch. Some root cuttings will develop shoots at the end which was nearest the parent stem, and roots at the other end; others develop roots and shoots anywhere along their length.

Layering Perennials

A few plants tend to root at nodes in contact with the soil, a process called



Campbell

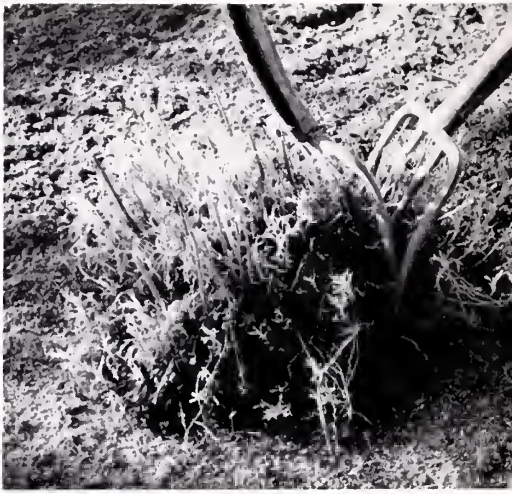
Dividing plant with hand fork.

Division is set in prepared soil.

layering. This can be encouraged by covering parts of stems with soil.

Multiplying Bulbous Perennials

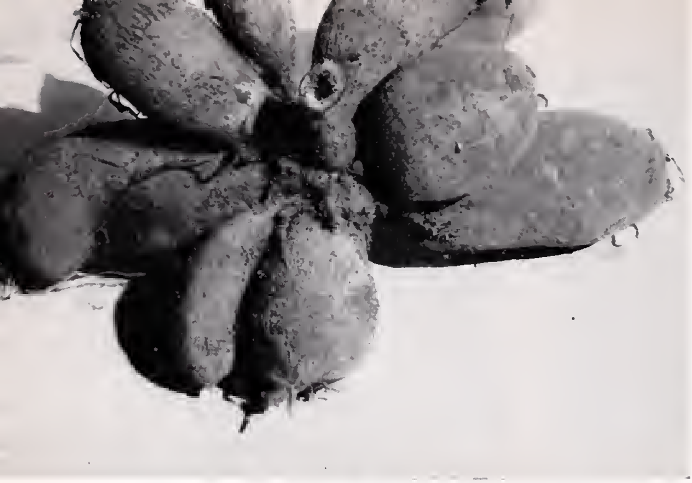
Spring-flowering bulbs, which are also perennials, are usually increased by removing the small bulbs or offsets that form at the bases of the mother bulbs and growing them in rich light soil



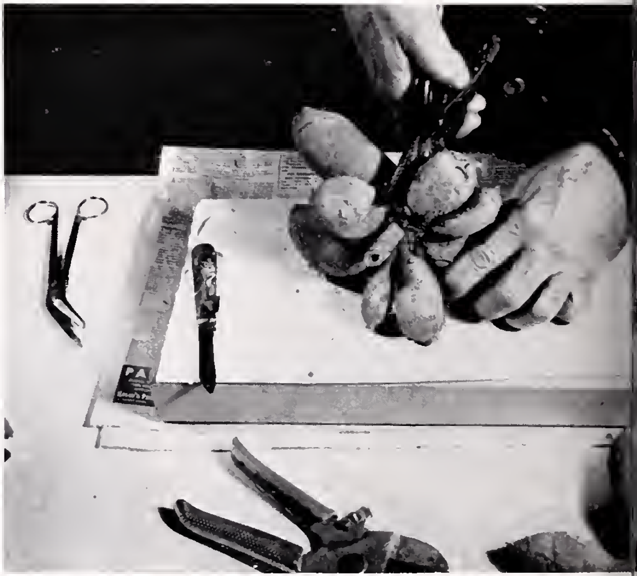
Alternate method of dividing plant using two garden forks back to back. Bringing handles of forks together separates parts of plant with minimum damage.

Gantner photos

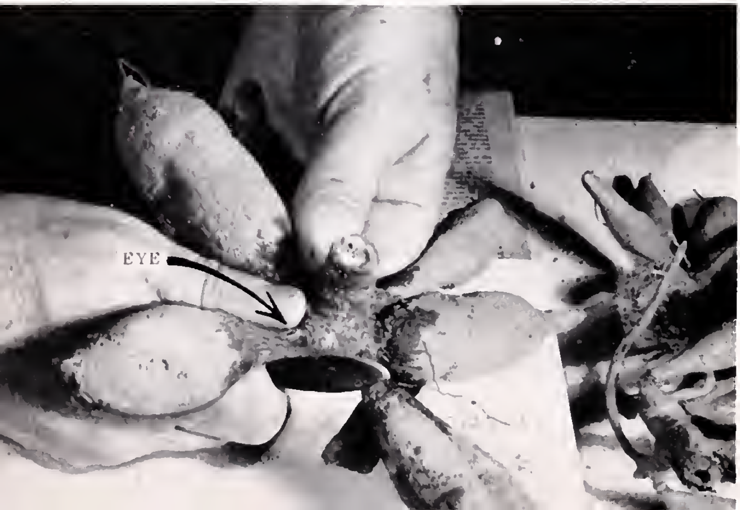
Planted division is thoroughly watered before hole is completely filled with soil.



Cluster of dahlia roots from storage, ready to be divided in spring.

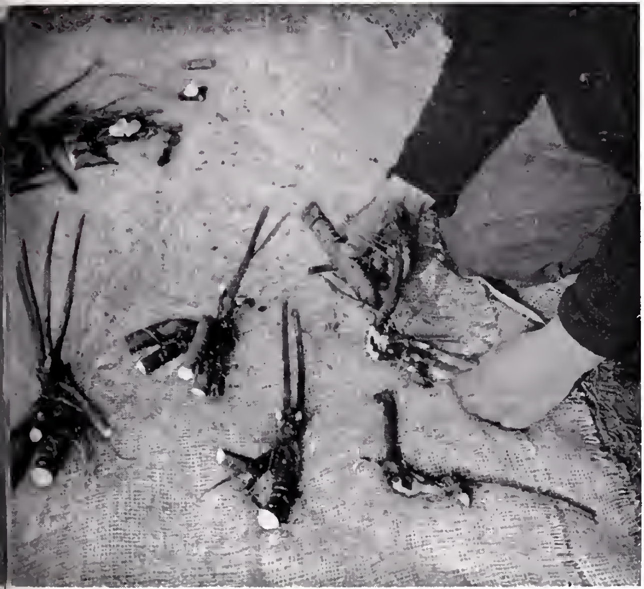


First division is made with heavy shears. On very large clumps a small saw can be used.



Individual tubers a cut off. It is of gre importance to include portion of the ne having an eye (bud) if this is not done t tuber will not produ a new plant.

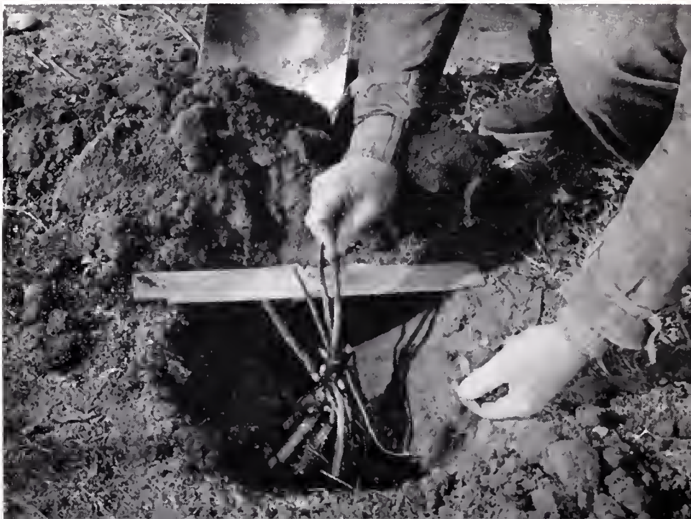
Washing soil from old clump of peony roots.

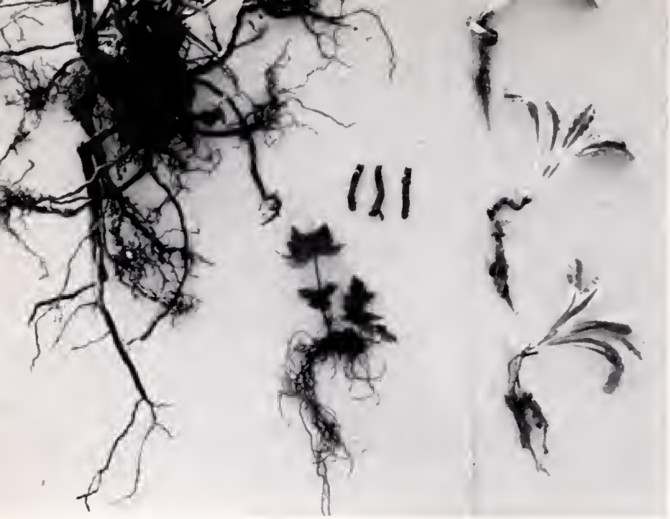


Making divisions of peony roots; for best results each division should have three to five eyes.

Roche photos

Planting division. Peonies should not be planted too deeply; topmost eye should be 2 to 3 inches below surface of soil.





Root cuttings. Left, plant of *Anemone japonica* with three root cuttings just made and one growing; right, three growing root cuttings of oriental poppy.

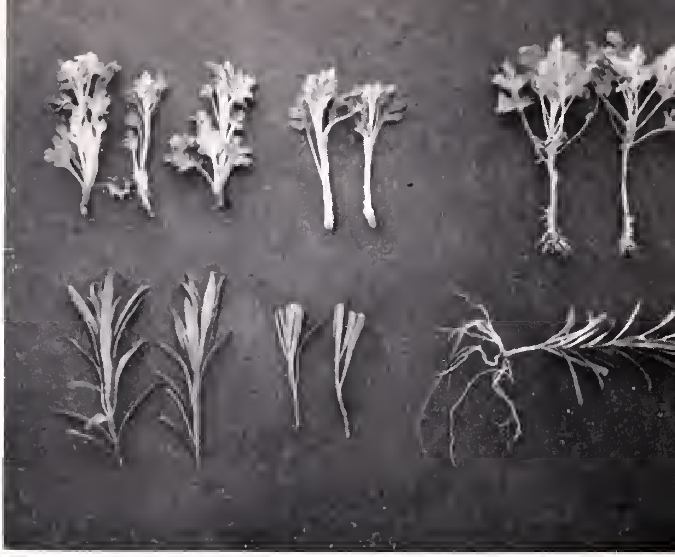
Singer

for two or three years. If tulips and narcissus are to be propagated this way they should be planted quite shallow; this will lead to the production of more offsets. Hyacinths can be induced to produce a large number of bulblets if the base of the mother bulb is scooped out or if it is scored with several diagonal cuts reaching about half way through the bulb. The operation is done in August and the treated bulbs are placed where it is light, warm and dry until October or November, when numerous small bulblets will have formed along the wounds. The whole cluster, old bulb and all, is planted about 5 inches deep. The following summer the young bulbs can be dug and separated, then replanted in the fall. It requires from two to five years to obtain flowering bulbs by these methods.

Lilies can be propagated in several ways. Many can be grown from seed, others from bulbils that form on the stems in the axils of the leaves. Some form such bulbils on the underground

Buhle

Iris should be divided about every third year. Clumps are dug from midsummer to early fall, rootstalks (rhizomes) cut into pieces as shown, the foliage trimmed, and the divisions replanted.



Stem cuttings of chrysanthemum (above) and penstemon (below). Left, rough cuttings; center, cuttings trimmed and ready to be rooted; right, rooted cuttings.

Photo author courtesy

portions of the stem. The bulbs of many lilies are formed of scales which furnish another method of propagation. The scales are detached, dusted with a fungicide and then placed in a warm propagating medium where bulblets will form at their bases. The time required for growing flowering-size plants in this way varies with the species from one to four years.

Other Methods

Grafting is not commonly used as a method of propagating perennials, but one plant, the double-flowering baby's breath (*Gypsophila paniculata* vars.), is grafted on single-flowering stock, as most of its seedlings are not double-flowering. Some sedums, hyacinths, and a few lilies can be increased by leaf cuttings.

Lily bulb showing scales.

Bulblets forming on hollowed out hyacinth bulb.

HOW TO PROPAGATE THIRTY HERBACEOUS PERENNIALS

Common Name	Scientific Name	How to Propagate
Columbine	*Aquilegia* spp.	Sow in August to bloom following spring. Large plants may be divided in early fall.
Hardy aster (Michaelmas daisy)	*Aster* spp.	Since garden varieties do not come true from seed, take divisions or root cuttings in early spring.
Garden spirea	*Astilbe* spp.	Divide plants in spring.
Bellflowers, harebells	*Campanula* spp.	Sow seed in late spring or early summer. Plants may be divided, cuttings rooted. The biennial Canterbury bells (*C. medium*) should be started from seed each year.
Chrysanthemum	*Chrysanthemum* spp. and hybrids	Divide plants in early spring or late fall.
Delphinium, Chinese larkspur	*Delphinium* spp. and hybrids	Sow fresh seed in August. Divide plants in early spring. Double-flowered and named varieties may be started from cuttings taken in early spring or in summer.
Sweet William, pinks, carnations	*Dianthus* spp. and hybrids	Sow seed in spring. Root 3-inch stem tip cuttings of double-flowered varieties after flowering. Grass pinks may be layered.
Bleedingheart	*Dicentra spectabilis*	Sow seed in spring or take 2-inch root or stem cuttings soon after growth starts.
Gasplant	*Dictamnus albus*	Sow fresh seed in fall. Will take 4 years to reach flowering size. Plants should be disturbed no more than necessary.
Foxglove	*Digitalis* spp. and hybrids	Perennial species may be grown from seed or divided. Seed of many which are treated as biennials is planted in late summer or early fall for next year's bloom.
Blanket-flower	*Gaillardia grandiflora*	Sow seed in spring (may not bloom first year). Take stem cuttings in late summer or early fall, root cuttings in late fall.
Baby's-breath	*Gysophila paniculata*	Sow seed or take 2-inch root cuttings in fall or spring. Double-flowered varieties are grafted on single-flowered rootstock.
Day-lily	*Hemerocallis* spp. and hybrids	Divide plants in spring or fall.
Coral-bells	*Heuchera sanguinea*	Divide plants in fall, sow seed in early spring (germination often poor).

Plantain-lily	*Hosta* spp.	Divide plants in spring. Some may be grown from seed.
Candytuft	*Iberis* spp.	Take cuttings in summer. Plants may also be started from seed.
Bearded iris	*Iris* hybrids	Divide large rhizomes in late summer or early fall.
Lily	*Lilium* spp. and hybrids	Propagate by bulb scales, some kinds form bulbils in leaf axils. Can be grown from seed, but some show "double dormancy" which must be overcome by special handling.
Lupine	*Lupinus polyphyllus*	Seed may be sown anytime, or plants may be divided. Cuttings of partly hardened wood may be taken in spring.
Forget-me-not	*Myosotis* spp.	Sow seed in summer. Divide plants or take cuttings in spring.
Nepeta	*Nepeta* spp.	Some branches usually layer naturally. Cuttings may be taken in spring or summer.
Evening-primrose	*Oenothera* spp.	Sow seed or divide plants in early spring. 2-inch root cuttings may also be taken.
Peony	*Paeonia* spp. and hybrids	Divide roots in late summer or early fall. See page 135.
Oriental poppy	*Papaver orientale* and varieties	May be divided in late summer, or 2-inch root cuttings may be taken. With care new plants can be obtained from seed, but those of the hybrids will not come true.
Summer phlox	*Phlox paniculata* and varieties	Divide clumps in fall or early spring. Clumps may be lifted, large roots removed for 2-inch cuttings, and the crowns replanted.
Balloon-flower	*Platycodon grandiflorum*	Sow seeds in early spring. Plants should not be moved more often than necessary.
English primrose	*Primula vulgaris*	Divide plants in spring after flowering, or in fall. Start seeds in early spring (germination is erratic, may take months).
Coneflower	*Rudbeckia* spp.	Divide plants in early spring. Most can also be started from seed.
Speedwell	*Veronica* spp.	Divide plants in fall. Most can be started from seed, some root where branches touch soil.
Sweet violet, viola	*Viola* spp.	Can be started from seed. Tip cuttings 3 inches long of violas can be rooted in late summer. Violet plants can be divided.

PROPAGATING HOUSE PLANTS BY CUTTINGS

Kathryn S. Taylor

THERE are many ways in which house plants can be propagated but for a great majority of them one of the best methods is to root softwood cuttings. Cuttings can be made at various times, but early spring (about March), when the plants are responding to increasing sunlight, is one of the best times for making them. August is also a good month for taking cuttings of many plants. A fairly good guide is the condition of the stem—it should snap when bent but hang by a bit of tissue. Sometimes cuttings of fuchsia, lemon verbena, and similar plants are taken too late in the fall when the wood has begun to harden. In this case the stem will crush where it is bent and not break off because the wood is too old. Cuttings made from such wood are apt to be harder to root. Young, vigorous stem tips usually root best. Weak and anemic cuttings will never produce healthy plants.

Making Cuttings

To make the cuttings the stem tips are cut off with a sharp knife just below a node. The cuttings may be from 3 to 5 inches long, and should contain at least two buds. The bottom leaves are carefully removed from the cuttings. If it is desired, the bases of the cuttings may be treated with root-inducing hormone powder, following the manufacturer's directions. Hormodin 1 and Rootone are both good, and there are others as well.

The cuttings, once made, must be induced to root by placing them in a moist medium, sufficiently well aerated and with proper light and heat. This

Gantner

Plastic food box makes small "greenhouse" useful for starting cuttings.

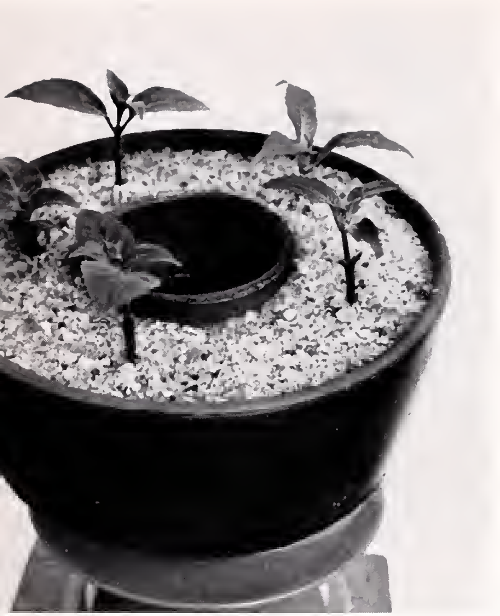
Taking cuttings from coleus plant; cuttings of many other house plants are taken in the same way.

Inserting cuttings in rooting medium after lower leaves have been removed. Coleus and some other plants can also be rooted in water.

Roche photos

Planting rooted coleus cuttings. Cuttings of coleus and other plants rooted in water must be handled carefully, as the roots are apt to be brittle.

Making cuttings of geranium; this should be done whenever plants become ''leggy.'' See table on page 144 for other plants that can be rooted this way.



Singer

Rooting fuchsia cuttings in marble chips.

is not so simple as it first appears and often cuttings wilt from lack of moisture or too much light, or rot because the rooting medium becomes too wet and soggy. During the rooting process the gardener's skill is put to the test, and the greatest watchfulness is necessary.

Rooting Materials

Two materials have been found good for almost any cuttings so far tried and should be of great help to the amateur. One is perlite, a white sterile material of volcanic origin which holds moisture well but remains better aerated than does vermiculite (expanded mica). Roots grow quickly in it and many window gardeners have reported success with it where they have failed with other materials. For softwood cuttings of geranium, lantana, fuchsia and heliotrope, and for leaf cuttings of begonia and succulents which rot very easily, perlite has given excellent results.

The other rooting medium is a mixture of equal parts of coarse sand and vermiculite. This has rooted everything from geraniums to camellias. In preparing the mixture, it is a good idea to sterilize the sand first by pouring boiling water through it.

Containers

Various containers are suitable for the cuttings. Two of the best are tin cans (a little smaller than coffee cans) and bulb pans (shallow flower pots). If a tin can is used, holes should be punched in the bottom, with one or two small ones on the side, near the bottom. The bottom should be covered to a level above the side drainage holes with pebbles or bits of broken pots. A small amount of coarse material — leaves, sphagnum moss or peat moss — should cover the pebbles. This is tamped down firmly. The same drainage material is used for the bulb pan. Also, this may have a small pot, its drainage hole stopped with a cork, placed in the center. After the cuttings are planted, this pot is kept filled with water, which slowly seeps through its sides, keeping the rooting medium constantly moist. Moreover, with this arrangement, the cuttings are nearer the outer edge of the pan, where for some reason they seem to root better. After the drainage material is in place a propagating compost made of one part loam, two parts peat moss, and three parts sand is placed in the container, leaving an inch or more at the top for the perlite or sand-vermiculite mixture. The containers should be watered before the cuttings are inserted. When all is ready, the cuttings are inserted. They should be set only deeply enough to be firm and the medium firmed around them so they will not come out when given a gentle tug.

A polyethylene freezer bag inverted loosely over the container of softwood cuttings provides a miniature propagating case (see pages 96 and 97). The cuttings should receive daily inspection for a time. If too much moisture condenses on the inside of the bag, remove it for a while and turn it inside out before replacing it. The excess moisture must be allowed to evaporate or the cuttings may get moldy, but the bag should be replaced before the cuttings wilt. The medium must be kept moist but never wet. The containers are put in a light place, but they should not receive direct sunlight.

Gentle bottom heat will accelerate the rooting of the cuttings and help to dispel excess moisture. Electric cables can be purchased, but a simple setup can be made by placing an electric light bulb under an inverted bulb pan on top of which the containers of cuttings are set.

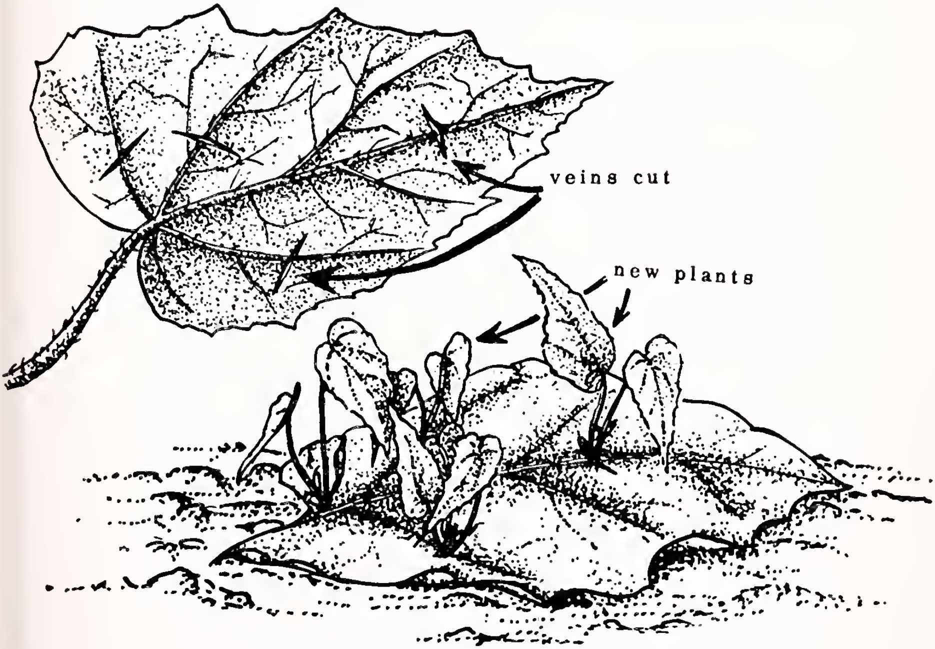
Special Treatments

Cuttings of cacti and other succulents should be allowed to seal over by being left in a shady, dry place for a few days before planting. They should not be watered until roots form. Geranium cuttings are also sometimes allowed to dry out for a day or two before planting.

Leaves of many succulents and sections cut across the leaves of sanseverias will root if placed upright in damp perlite. Leaves of some kalanchoes and bryophyllums will produce new plants around the edges without the aid of a rooting medium.

Rex begonias are grown from either shoot cuttings or from leaf cuttings. To make these, mature, healthy leaves are chosen. The larger veins are cut on the underside and the leaf pegged down with toothpicks or held down with weights on damp rooting medium. The leaves must be carefully shaded until rooting takes place at the cuts. Another method is to cut a triangular piece of leaf with a bit of its stem attached. This will root if the lower end is set about 1 inch deep in the medium.

Leaves of rex begonias will produce new plants if they are cut across the larger veins on the under side and pegged down to damp sand. New plants begin at each cut.



HOW TO PROPAGATE 100 HOUSE PLANTS

Scientific Name	Common Name	How to Propagate
Abutilon spp.	flowering maple	stem tip cuttings, seeds
Acorus gramineus variegatus		division
Adiantum spp.	maiden-hair fern	division, spores
Aechmea spp.	airpine	offsets, suckers
Aeonium spp.		leaf cuttings, offsets
Agapanthus spp.		seeds, division
Aglaonema modestum	Chinese evergreen	stem tip cuttings, air layer
Aloe variegata	Kanniedood aloe	offsets
Amaryllis spp.		seeds (slow), bulbs
Anthericum spp.		offsets
Anthurium spp.		division
Araucaria excelsa	Norfolk Island pine	stem tip cuttings, shoot cuttings
Ardisia crenata	coral berry	step tip cuttings, seeds
Asparagus plumosus	asparagus fern	seeds, division
Asparagus sprengeri		seeds, division
Aspidistra elatior	cast-iron plant	division
Asplenium nidus	birds-nest fern	spores
Azalea spp.		stem tip cuttings, seeds
Begonia rex		stem tip cuttings, leaf cuttings
Begonia semperflorens		stem tip cuttings, seeds
Beloperone guttata	shrimp plant	stem tip cuttings
Billbergia spp.		division
Caladium bicolor		bulbs
Calathea sanderiana	Sanders calathea	division
Camellia japonica		stem tip cuttings
Capsicum frutescens var. *conoides*	tabasco redpepper	seeds
Ceropegia woodi	rosary vine	stem tip cuttings, aerial tubers
Chlorophytum capense	spider plant	offsets, runners
Cissus antarctica	kangaroo vine	stem tip cuttings
Clivia miniata	Kafir-lily	division
Coleus spp.		stem tip cuttings
Crassula arborescens	jade plant	stem tip cuttings, leaf cuttings
Cryptanthus sonatus var. *zebrinus*		offsets
Cyanotis somaliensis	pussy ears	stem tip cuttings
Cyclamen persicum	florists' cyclamen	seeds
Cyperus alternifolius	umbrella plant	leaf cuttings, division
Dieffenbachia spp.	dumbcane	stem tip cuttings, air layer
Dracaena fragrans		air layer
Dracaena godseffiana		stem tip cuttings, air layer
Echeveria spp.		leaf cuttings, offsets
Epiphyllum spp.		stem tip cuttings
Episcia cupreata		leaf cuttings, runners
Euphorbia pulcherrima	poinsettia	stem tip cuttings
Euphorbia splendens	crown-of-thorns	stem tip cuttings
Fatshedera lizei		stem tip cuttings
Ficus elastica	rubber plant	leaf cuttings, air layer
Ficus lyrata	fiddle-leaf fig	stem tip cuttings, air layer
Ficus pumila	climbing fig	stem tip cuttings
Ficus radicans var. *variegata*	variegated rooting fig	stem tip cuttings
Fittonia verschaffelti	tall fittonia	stem tip cuttings
Fuchsia spp.		stem tip cuttings

Gardenia spp.		stem tip cuttings
Gasteria hybrida		offsets
Gynura aurantiaca	velvet plant	stem tip cuttings
Haworthia spp.		offsets
Hedera helix	English ivy	stem tip cuttings
Helxine soleiroli	baby's tears	division
Hoya carnosa	wax plant	stem tip cuttings
Impatiens sultani	touch-me-not	stem tip cuttings
Kalanchoe blossfeldiana		leaf cuttings, seeds
Kalanchoe daigremontana		small plants form on leaves
Kalanchoe pinnata	air plant	small plants form on leaves
Kalanchoe tomentosa		leaf cuttings
Lachenalia tricolor	Cape cowslip	offsets
Lantana spp.		stem tip cuttings
Malpighia coccigera		stem tip cuttings
Mammillaria microcarpa	fish-hook mammillaria	seeds, offsets
Maranta leuconeura var. *kerchoveana*	prayer plant	stem tip cuttings, division
Monstera deliciosa	ceriman	stem tip cuttings, air layer
Neomarica gracilis	apostle plant	division, new plants from flower shoots
Nephrolepis exaltata var. *bostoniensis*	Boston fern	division, offsets, runners
Notocactus leninghausi		seeds, offsets
Oxalis rubra		division
Pandanus veitchi	screw-pine	stem tip cuttings, offsets, suckers
Pelargonium hortorum	zonal or fish geranium	stem tip cuttings
Pelagonium peltatum	ivy-leaved geranium	stem tip cuttings
Peperomia obtusifolia		stem tip cuttings, leaf cuttings
Peperomia sandersi var. *argyreia*		leaf cuttings, division
Philodendron oxycardium		stem tip cuttings
Pilea microphylla	artillery plant	seeds, division
Pteris cretica var. *albo-lineata*		division, spores
Primula malacoides	fairy primrose	seeds
Saintpaulia ionantha	African-violet	leaf cuttings, division
Sansevieria zeylanica	snake plant	leaf cuttings, division
Saxifraga sarmentosa	strawberry-geranium	division, runners
Schlumbergera bridgesi	Christmas cactus	stem tip cuttings
Scindapsus aureus	Solomon Island ivy-arum	stem tip cuttings
Selaginella uncinata	blue selaginella	stem tip cuttings
Sempervivum spp.	house-leek	offsets
Senecio cruentus	cineraria	seeds
Sinningia speciosa	gloxinia	leaf cuttings, seeds,
Solanum pseudo-capsicum	Jerusalem cherry	seeds
Stapelia grandiflora	carrion flower	seeds, division
Syngonium podophyllum		stem tip cuttings
Tolmiea menziesi	pick-a-back-plant	leaf cuttings, offsets
Tradescantia spp.	wandering jew	stem tip cuttings
Veltheimia viridifolia		bulbs
Zantedeschia elliottiana	golden calla	seeds, division, bulbs

HOW TO PROPAGATE CHRYSANTHEMUMS BY CUTTINGS

V. R. de Petris

AUTUMN-flowering chrysanthemums are perennial, and where hardy enough to survive the winter, they can be increased in the spring simply by dividing the plants. In many regions, however, they cannot easily be brought through the winter; in such places they must be propagated by cuttings. Plants cut back after flowering and held over in greenhouse or cold frame provide shoots to use for making the cuttings. Only healthy plants completely free from all pests and diseases should be used for stock plants. The number of plants to be kept for stock depends to some extent upon the variety. Some are difficult to winter-over, even in a cold frame, and will produce relatively few shoots, perhaps only five or six; others may produce fifteen or twenty.

Caring for Stock Plants

After cutting back, the stock plants are lifted with plenty of soil on the roots. They are set in flats or other convenient containers and placed in a cold frame or a cool greenhouse. If in a cold frame, they are not covered until the weather becomes quite cold. The ideal is to hold them near the freezing point until they begin growth in the spring. In the most severe weather the cold frame may be covered with boards as added protection. Most chrysanthemums will not be harmed even if the temperature in the frame does go below freezing. If a greenhouse is available the plants may be moved from the cold frame to the greenhouse around March, and growth of new shoots will begin. If no greenhouse is available, the boards and other shading are removed from the cold frame so that the warming effect of the sun will stimulate growth. On unusually warm days the glass should be lifted a little to prevent overheating, which will make the shoots too soft. Shoots are usually ready for cutting by the end of March or early April.

If stock plants are kept in a greenhouse at a temperature of 50° to 55°F. all winter, shoots will be ready for cutting from the end of January on. Cuttings taken this early are affected by the short day length, which may stimulate formation of flower buds, undesirable on young plants. To prevent this, 60-watt lamps should be placed directly over the stock plants at 4- or 5-foot intervals; during February they should be turned on for 4 hours at the end of the day. With stock plants kept at near-freezing temperatures until March or April, formation of flower buds is no problem.

Containers and Rooting Media

Cuttings may be rooted either in bulb pans or 4-inch-deep wooden flats. For the average home gardener with few plants, the bulb pans are probably more convenient. In either case, ample drainage should be provided.

Formerly, screened sharp sand was the standby for rooting the cuttings, but recently better results have been obtained by thoroughly mixing equal parts of sharp sand and vermiculite (sold under the trade name, Terralite). Another mixture many commercial propagators

Chrysanthemum cutting trimmed and ready for insertion into rooting medium.

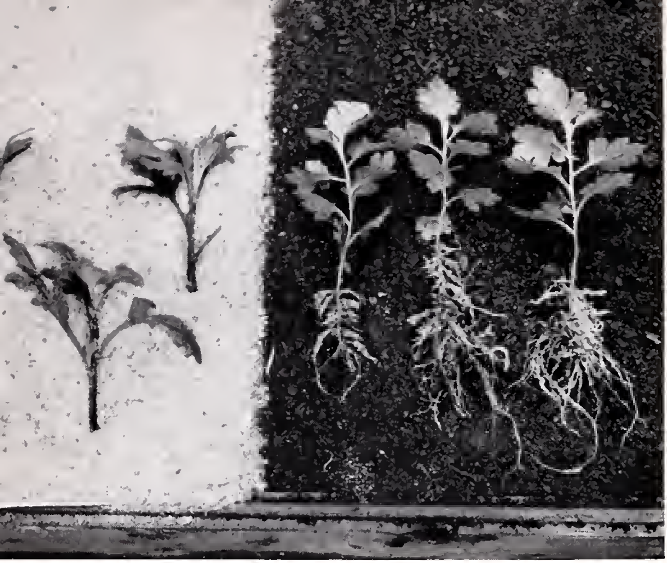
favor consists of two parts sand and one part peat moss. To this mixture some propagators add ground volcanic stone, sold under the name perlite, to give an even more porous mixture. No nutrients in any form should be added to any of the rooting mixtures. A night temperature of 50° to 55° F. is ideal for rooting the cuttings, but the amateur need not worry too much about this. All that is necessary is to avoid overheating. If the cuttings are rooted in a cold frame, the top should be opened during the day, taking care that the cuttings do not get too dry; if in the house, the cuttings should be removed from direct sunlight on clear days.

Taking Cuttings

Cuttings should be taken from the stock plants when the shoots are plump and turgid. The cuttings should be 3 to 3½ inches long, and trimmed to retain four to six leaves. If a rooting hormone powder is used it does not matter greatly whether the cutting is separated from the shoot at a node or between nodes. After trimming, the cutting should be thrown into cool clean water for an

Photos author courtesy

Inserting chrysanthemum cutting into rooting medium.



Chrysanthemum cuttings ready for rooting (left) and rooted (right). Chrysanthemum cuttings apparently root better if cut straight across the base rather than on a slant.

le

hour. This will increase its turgidity and help prevent wilting in the rooting medium.

Before inserting the cuttings into the rooting medium they should be dipped into a 3 per cent solution of Fermate to destroy fungi. Then, if root-inducing hormone is used, the ends of the cuttings are dipped into it. Most of these hormones are sold as powders under various trade names, such as Rootone, Hormodin, Nurute, QuickRoot, etc. Then the cuttings are inserted in the rooting medium to a depth of 1 to 1½ inches, and the medium pressed firmly around them.

Caring for Cuttings

After planting, the cuttings should be shaded from strong light until they have begun to make roots—usually about ten days. Hard stems may require somewhat longer. The cuttings should be kept moist, neither too dry nor too wet. They should not be exposed to drafts, but there should be a gentle circulation of air about them. If they show a tendency to wilt, watering with a fine spray or mist followed by covering with newspapers will freshen them. Covering with wet newspapers will also be helpful. Amateurs handling a few cuttings may find that the use of polyethylene film solves most of the problems (see page 96).

Ordinarily the cuttings will be rooted in fifteen to eighteen days. They are well rooted when they resist pulling from the sand on tugging them. Once rooted, they should not be allowed to remain in the rooting medium very long.

Planting Rooted Cuttings

After rooting, the cuttings should be planted in rich loam to which is added a fourth to a third peat moss, the amount depending upon the texture of the soil. A little well rotted manure is an excellent supplement. The cuttings may be planted individually in 2½-inch pots or in flats. With large numbers of cuttings, planting 28 in a flat 12 inches by 24 inches by 4 inches has been found an excellent way to handle them. The young plants should be shaded during the day for four or five days after planting, thereafter only from the bright sun. Once well established they need not be shaded at all.

The plants are set out in permanent locations when all danger of frost is completely past. In the vicinity of New York City this is usually in early June. The plants are removed from the flats by cutting the soil and roots with a table knife, leaving a 3- by 3-inch square of soil and roots around each young plant.

GRAFTING TREE PEONIES

An excellent method of propagating hese beautiful plants

Harold E. Wolfe

THOUGH tree peonies can be increased by division, by layering and by rooted cuttings, root-grafting is the most rapid and easy method of securing ncrease in stocks of existing plants. The erm, "rapid," is used here in a relative ense only, for the propagation of tree peonies is a slow enough process at best.

Choosing Understock for the Graft

Both tree and herbaceous peony roots an be used as understock; each has its dvantages. For while tree peonies graftd on tree peony roots grow and develop aster, herbaceous peony roots are much asier to obtain. From the standpoint of elationship between scion and undertock, three types of graft combinations re possible.

The first is that in which both scion nd understock are of the same variety; his is the most desirable, for just as soon s union has taken place, one has an ownoot plant. All growth, whether from tem or root, will be of the same variety.

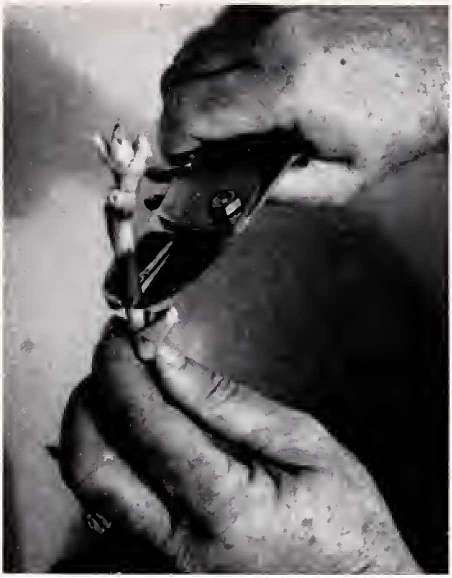
Another type of graft is that in which ree peony understock is used, but of a ariety other than that of the scion, or f a seedling. While this type of grafted ree peony, as in the case of the first, rows better than those grafted on herbaceous roots, it must be remembered that ventually the understock will start sending up suckers. In many instances aparently established plants of good varieies have been nearly crowded out by a orest of suckers arising from a seedling nderstock more vigorous than the scion ariety. The proper procedure is, of course, to lift the grafted plant once the cion is well established on its own roots nd clip off the understock. This leaves fine young plant that can be replanted for further growth. If the plants are not required for immediate use, such as sales, they may be left on understock for several years before suckers become a problem.

The third type of graft combines a tree peony scion with a herbaceous understock. Roots of both hybrids and species have been used, with no appreciable difference. Those of *Paeonia albiflora,* the one generally available, are as good as any. The affinity of scion and understock is quite good, despite their somewhat different growth habits and roots. Not only are these roots easier to come by, but they are also easier to work with. (Tree peony roots, it should be pointed out, have an exceedingly hard rattan-like core which can be a problem when making grafts.)

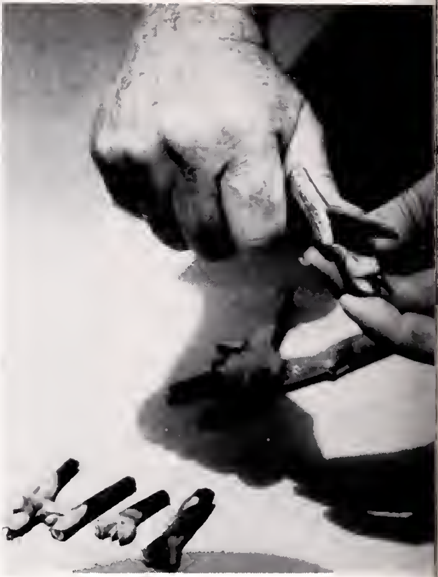
Herbaceous understocks may also produce suckers later on, but worse, they often form huge, grotesque, ball-shaped masses — sometimes as large as basketballs, and hardly distinguishable as roots. These take up space that could be used more advantageously by the tree peony for its own roots.

Making the Graft

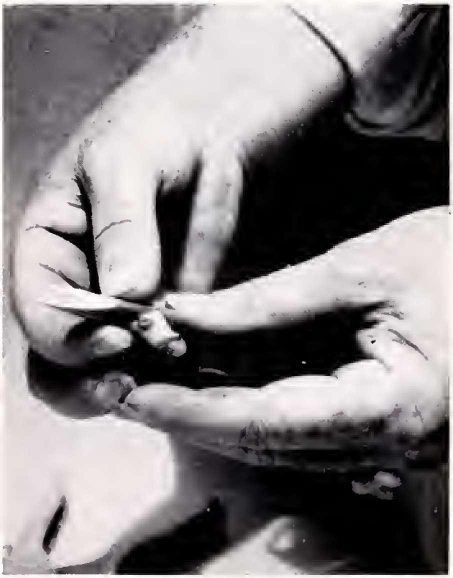
There is no one way and perhaps no best way to make and handle tree peony grafts. The procedure may vary with climate, with personal preference, and with the material available. One requisite is that the scions be taken at the proper time; but this is not critical. The wood seems to be sufficiently matured a little while before the seeds have ripened, here in southern Illinois, around August 15. (There are no seeds on many hybrids, but their readiness period is the same.) Grafting is begun then, continuing, as time permits, through mid-October. Grafts have been successful when made as early



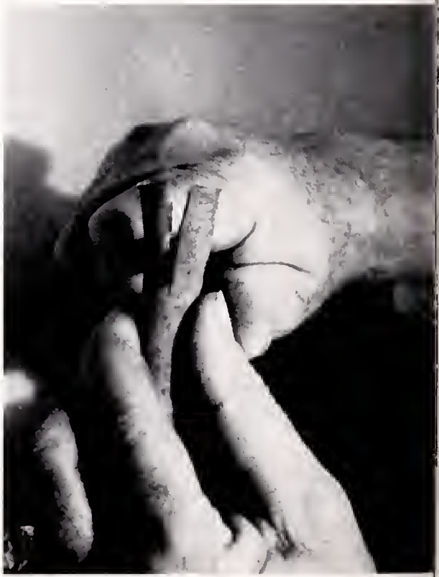
Cutting a terminal bud scion of tree peony. Second cutting will be taken just above the next bud down the shoot, and so on to the bottom.



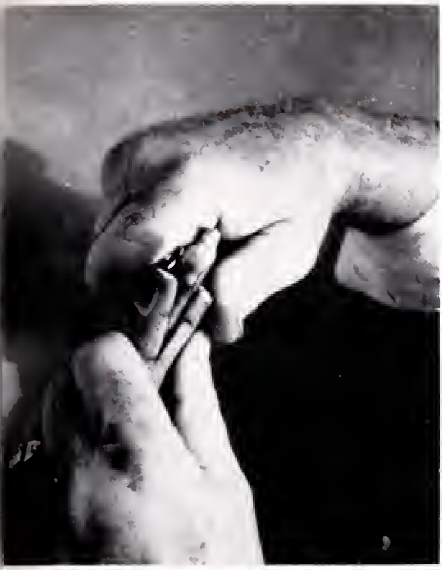
Cutting a wedge at base of scion. In pra
tice it is better to work from the botto
of a shoot, shaping the base of each scio
before removing it.



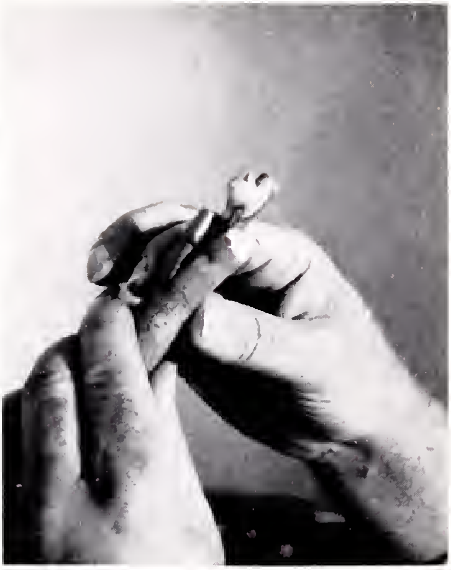
Completed scion showing wedge-shaped base. Care must be taken to have the faces of the wedge flat and the base straight.



Slitting upper end of understock; slit
slightly longer than wedge-shaped base
scion. Understocks are pieces of youn
herbaceous peony roots ½ to 1 inch thic
and 4 to 7 inches long.

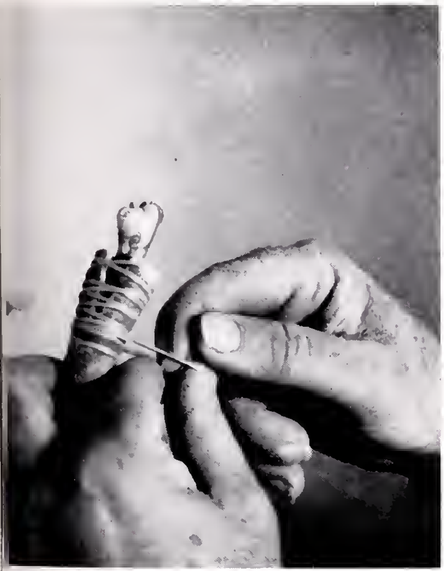


Scion is inserted well into slit in understock and bevel cuts are made on stock to help hold rubber band secure when graft is wrapped.

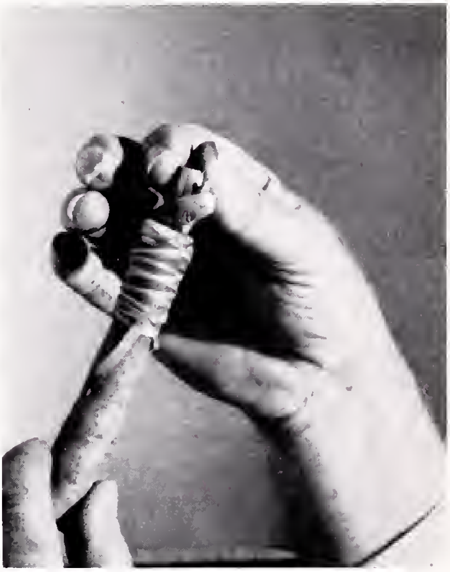


Scion fits snugly into slit in understock and graft is ready for wrapping.

Photos author courtesy



Wrapping graft with rubber band. Number 3 band, cut at one end is just right or special rubber budding bands can be used.



Wrapping is begun just below split in understock, carried up and around bevel cuts, then back down and tied in by slipping end under a bottom loop, completing the graft.

as August 1, and it is possible that the process could be carried on later into the fall, but it is hardly practicable here.

One may make either wedge, triangular, side or whip grafts. But because it is easiest to make, and for no other reason, the author uses the wedge graft almost exclusively. The understock is simply split at its upper end, and the scion, wedge-shaped at the bottom, is pushed well down into the split; then the graft is wrapped with a rubber band (see illustration on page 151). Rubber bands are ideal, for they do not rot, and maintain over a sufficient period a constant pressure on the surfaces that are to unite, but never keep their tension long enough to interfere with growth.

While two-bud scions are preferable from the standpoint of earlier production of own-root plants, it is probable that with a limited amount of scion wood available it is more advantageous to have a greater number of one-budded plants than fewer two-budded ones.

In practice the stem is not cut into scion segments, each to be made wedge-shaped later. Instead, it is much easier to sever the stem at its base, shape the bottom scion, clip it off just above the proper bud, and repeat this procedure until the entire stem is used up. The reason for this is evident: it is easier to hold and work with the scion wood.

Caring for the Graft

As soon as a graft is made it is dipped into Clorox or Purex solution (1 tablespoonful per gallon of water) and tossed into a box of damp but not soggy sphagnum moss. As soon as a number have been made, or as soon as conveniently possible, the grafts are placed in sawdust in a well-drained, shaded spot and under mist. Fresh oak sawdust is fine for this. The grafts are laid side by side on a 2-inch layer of sawdust. As many as six layers of grafts are piled up before covering with 3 to 4 inches of sawdust. Then the mist is turned on. It does not need to be constant; our practice is to use it only from morning to late evening. Within three weeks most of the grafts will hav knit together; however, it is best not t remove them at this time, as the understocks will root sooner if left undisturbed

Later on the grafts are placed in shovel-wide, 4-inch-deep trench, with soi loosened at the bottom. The grafts ar laid horizontally, about 3 inches apart budded ends to the outside, understock t the center. The trenches are then fille with friable soil and covered with severa inches of sawdust. They require no mor attention until weeding becomes necessary Minimum cultivation is advised. Som tree peonies will push through early an some as late as the end of June, thoug except for those grafted on tree peon understock, few will bloom the first yea and fewer still the second.

It should be noted that satisfactor graft wood is difficult to obtain in quantity from old specimen plants. Annua growth is not great, and internodal space are quite short. The best scions are obtained from plants which were cut to th ground the preceding fall. Their stem will be long and internodal spaces correspondingly longer. But this procedur brings on its own problem, for in a fe years a plant handled in this manner becomes literally a thicket of stems, an thus more subject to the fungus, botryti the only serious enemy a tree peony ha (though rabbits, which consider the terminal buds of young plants to be a grea delicacy, are somewhat of a menace).

Undoubtedly, the growing-on procedur can be improved. It is entirely probabl that if the grafts, their union accomplished, were placed in partial shade an mist and in a good growing medium an then grown on in it for a couple of year their progress would be much faster.

And it is equally certain that there ar other good methods of handling the graft for the first year or so. In climates colde than that here in southern Illinois th procedure I have described above woul not work. N. I. W. Kriek, at Lansing Michigan, and William Gratwick, nea Rochester, New York, use other method quite successfully.

Buhle

Prairie crab-apple (*Malus ioensis*).

PROPAGATING CRAB-APPLES

Arie F. den Boer

As a youth I was once taken to a nursery where some men were grafting evergreens. They had small potted conifers, on which they grafted another kind. That seemed like magic to me. All they had to work with was a sharp knife, some cotton thread and skill, a lot of skill evidently. They were very fussy about how scion and understock fit together. And why should they not be? They were cast in the role of creators and they wanted each product of their skill to be a masterpiece.

Little did I know then that a few years later I would be initiated into the great guild of propagators by first learning to graft peegee hydrangea, clematis (I still remember vividly the spaghetti-like roots of *Clematis viticella alba*, which was used as understock), rhododendrons, azaleas, evergreens of all descriptions and — this was really an easy one — flowering crab-apples. I say easy because the method used in the nursery where I was employed was probably the simplest of all, the common splice graft, in which understock and scion are cut with the same slant, fitted together, tied and waxed. American nurserymen prefer the whip graft in which a cleft is made in the slants of understock and scion. Otherwise the operation is the same.

The varieties most in demand in those days, that is forty or fifty years ago, are still counted among the best. Some of these are *Malus purpurea*, *M. spectabilis*, *M. halliana parkmani*, *M. floribunda* and *M. f. scheideckeri*; *M. baccata*, the Siberian crab-apple, was the favorite understock.

Budding and Grafting Crab-apples

During the first two or three decades of this century interest in this group of ornamental plants was rather scant, but since 1930 there has been a tremendous change; flowering crab-apples are now in great demand. Nurserymen are raising them in greater quantities than ever before, not only by grafting but also by budding. There is little difference in the results, whichever the method. A two-year grafted plant may be somewhat smaller than a so-called two-year budded plant, but it actually requires three years to produce the latter, which has a correspondingly heavier root system than the grafted plant, which was produced in only two years. However, budding, since it requires only a single bud of the scion variety, often enables the propagator to produce a larger number of trees than would be possible by grafting. This is particularly important in the case of new varieties.

Crab-apples From Seed

The species can also be raised from seed, provided that it is obtained from trees isolated from other apple or crab-apple species and varieties. Seedlings of the native American species, such as the Iowa crab-apple (*M. ioensis*) and the eastern sweet crab-apple (*M. coronaria*), have a sparing root system, but if transplanted when one or two years old the results are usually quite satisfactory. The beautiful tea crab-apple (*M. hupehensis*), the Sargent (*M. sargenti*), the Honan (*M. honanensis*), the Kansu (*M. kansuensis*) and the Toringo (*M. sieboldi*), all species, can be raised from seed. But the nurseryman will probably find that he can grow a saleable plant much faster by budding or grafting and the time factor is important in his business.

Outstanding New Varieties

During the past fifteen or twenty years a number of new varieties have been introduced. They have to be very good to compete with the old standbys mentioned earlier or they will not last. Some of the outstanding ones that can successfully compete are Katherine with double white blossoms, Van Eseltine with large rose-pink blossoms (as good or even better than the best of the double-flowering cherries), the deep purple-red Lise (a hybrid of the Lemoine crab-apple bu blooming earlier), and Dorothea wit beautiful double red flowers.

A few excellent new crab-apples wit purple foliage and flowers are Crimso Brilliant with single and semi-doubl flowers, Irene and Purple Wave.

Some new introductions deserve special notice for their beautiful, ornamental fruits. The weeping form, Red Jade is very attractive in the fall when th slender, drooping branches are loade with masses of small red fruits. Thi variety, incidentally, was introduced b the Brooklyn Botanic Garden. Anothe fine red-fruited crab-apple is Red Bud Among the yellow-fruited forms, Winte Gold is one of the best.

Dwarfing Crab-apples

Most of the newer varieties mentione are fairly large shrubs or small trees Since there is some demand for smalle types (because they require less spac and are easier to care for), horticulturist have tried dwarfing crab-apples by budding or grafting on an apple understock such as Doucin or some of the Malling selections which tend to slow dow growth.

Another method is to bud or graft th dwarfing stock on the understock normally used, and then to bud or graft th desired crab-apple variety on the dwarfing, or intermediate, stock.

To produce a dwarf tree Dr. Karl Sax of the Arnold Arboretum has suggested budding Sargent crab-apple, a rather slow grower, on seedlings of the Sikkim crab-apple (*M. sikkimensis*) and then budding the Sargent, or intermediary stock, to the desired crab-apple variety. He has also shown that dwarfing can be accomplished by "ringing" the tree, that is, removing a 1-inch ring of bark from the tree 1 foot above the ground, replacing the bark upside down and taping it, so that the bark will heal over. This procedure presumably causes an obstruction in the flow of sap and this is thought to dwarf the top.

A PROPAGATING FRAME FOR ROOTING DIFFICULT CUTTINGS

Developed for blueberries, this frame may be worth trying on other plants difficult to root

Stanley Johnston

BLUEBERRIES are not easy to propagate by ordinary methods, and require special treatment as well as careful attention. The method described below, used commonly in Michigan, is easier for the home gardener to follow than the more elaborate ground beds and lath houses used in some blueberry-growing areas. Some gardeners may wish to try the method also on other plants that are difficult to root.

A so-called box propagating frame is used (see illustration). It is commonly the length and width of a storm sash, but dimensions may vary to accommodate glass sash of various sizes. The height of the frame is unimportant as long as an air space is left between the cutting tray and the ground.

The cutting tray is made of 4-inch lumber with ⅛- or ¼-inch mesh hardware cloth stapled on the underside. This tray rests on braces nailed on the inside of the frame 8 inches from the top. After the cuttings are inserted, the glass sash and shade are placed on top of the frame. Recent investigations indicate that a sash covered with natural-colored plastic is as satisfactory as glass, and in addition has definite advantages. Burlap similar to that used for bran sacks makes the best shading material.

The propagating frame should be located in open sunlight, well removed from buildings and trees.

Material in Which to Root Cuttings

Ground peat moss has given the best results as a material in which to root blueberry cuttings. Tests to date indicate that the best sources of peat moss for blueberry propagation are northern and western Europe and the Canadian province of British Columbia. Bales of peat moss from these sources can usually be obtained from garden supply shops. Soak the peat moss in a tub or tank for several hours before placing in the cutting tray. Fill the tray to the top, but do not pack. Do not add soil, fertilizers or other materials to the peat moss.

Making and Inserting the Cuttings

Cuttings of sound wood produced the previous season are made in early spring, just before the leaves unfold. They can be taken just after growth starts provided that the leaves are still undeveloped. With a sharp knife or very thin-bladed pruning shears cut the stems into 4-inch lengths.

It is best to insert the cuttings as soon as made. If it is necessary to store them, keep them cool and avoid wet packing. The cuttings are inserted by being slanted into the peat moss about two-thirds of their length, in rows 2 inches apart, and about 1 inch apart in the row. They are sprinkled thoroughly after planting and then the sash and burlap shade are placed over the frame. Sufficient ventilation may be obtained by permanently blocking up the sash about 3/16 of an inch on one side.

Watering, Sanitation and Ventilation

The frames should be examined each morning to see if they need watering and to remove dying cuttings, leaves showing fungus infection, and foreign matter.

If moisture can be squeezed from the peat moss, it is moist enough. If watering is needed, however, only warm water

Special propagating frame with shade removed to show cuttings in place.

Photos author courtesy

should be used. Never water the cuttings in the heat of the day or in early evening. At these times the temperature in the frame often rises above 90°F. Unless the water is as warm as the cuttings, they might be injured. To avoid this risk, it is better to water the frame early in the morning.

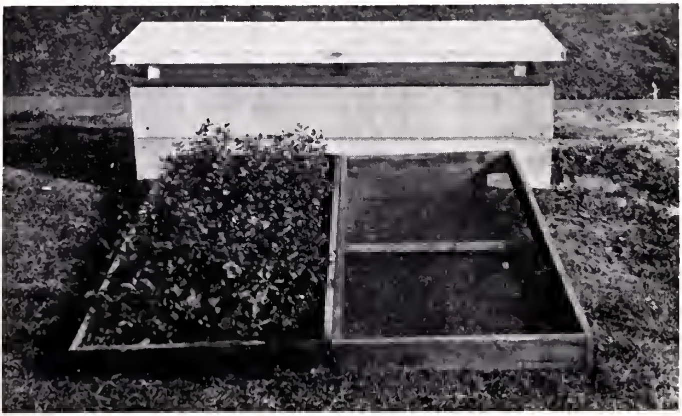
Fungus infection may cause serious loss unless good sanitary measures are followed. To date no satisfactory fungicidal sprays or dusts have been found that can safely be used in the warm, moist atmosphere of the propagating frame.

Later Care

Blueberry cuttings root slowly; it will usually take two to three months for most of them to root. By this time ventilation can be increased gradually. About tw weeks later the sash can be remove It is best to leave the shade on the fran until fall.

In late fall the tray of cuttings ca be carefully lowered to the ground insid the propagating frame and left ther over the winter. Do not cover wit leaves or straw as mice may nest i this material and injure the cutting In the spring the rooted cuttings ar removed from the trays and planted i their permanent location.

NOTE: More detailed instructions o blueberry propagation are given in Circu lar Bulletin 188, *Essentials of Blueberr Culture*, Michigan Agricultural Exper ment Station, East Lansing, Michiga A copy may be obtained without charg



Foreground, empty tray to show construction and tray filled with cuttings; background, frame with shade in place.

BOOKS ON PLANT PROPAGATION

Compiled by Viola Briner

THE NURSERY MANUAL by Liberty Hyde Bailey. Revised edition. Published by The Macmillan Company, New York, 943. 456 pp. $5.75.

A standard work on propagation by one of the greatest horticultural editors of this century. The principles of propagation are given as well as specific instructions for multiplying the most common groups of plants, such as lilies, bromeliads, cacti, annuals, biennials and perennials.

PLANT PROPAGATION by E. J. King. Published by Farrar, Straus and Cudahy, Inc., New York, 1952. 264 pp. $4.00.

A well-rounded guide to plant propagation. Concise tables of the most successful propagating techniques for common garden plants, trees and shrubs.

PLANT PROPAGATION by John P. Mahlstede and Ernest S. Haber. Published by John Wiley & Sons, Inc., New York, 1957. 413 pp. $7.50.

In this text, which student, nurseryman, seedsman and home gardener will appreciate, special attention is given to recent technical advances which have been made in plant propagation. All methods of plant propagation are discussed, including the increasing of spore-bearing plants.

SECRETS OF SUCCESSFUL PROPAGATION; METHODS OLD AND NEW by Artie Alvin Longmire. Published by Schauer Printing Studio, Santa Barbara, California, 1949. 142 pp. $3.00.

A concise, non-technical portfolio consisting of illustrations of plant parts used in propagation and brief text giving procedure used in increasing plants.

FLORIST CROP PRODUCTION AND MARKETING by Kenneth Post. Published by Orange-Judd Publishing Company, Inc., New York, 1950. 891 pp. $10.00.

Contains over five hundred pages on the propagation and culture of plants grown for the florist trade. One of the most complete references on the production of florist crops, both under glass and out-of-doors.

THE GRAFTER'S HANDBOOK by R. J. Garner. Published by Oxford University Press, New York, 1949. 223 pp. $4.50.

The various methods of grafting, the preparation of rootstock and scion-wood and compatibility in graft unions are described from a scientific approach.

HOW TO INCREASE PLANTS by Alfred Carl Hottes. Revised edition. Published by Dodd, Mead & Company, New York, 1949. 279 pp. $3.50.

A typical Hottes book, very clearly written, informative and interesting; an excellent reference for the home gardener. Eight chapters are devoted to the fundamentals of plant propagation. The remainder consists of specific instructions for the propagation of commonly grown plants.

SIMPLE PROPAGATION by Noel J. Prockter. Published by Transatlantic Arts, Inc., Hollywood-by-the-Sea, Florida, 1951. 144 pp. $1.75.

Basic information on propagating the familiar garden and greenhouse plants. Excellent photographs supplement the text.

PLANT PROPAGATION AND GARDEN PRACTICE by R. C. M. Wright. Published by Criterion Books, New York, 1956. 192 pp. $4.50.

This book is written for the home gardener and includes chapters of special interest to the amateur such as "Natural Vegetative Increase," "Harvesting and Storage of Seed" and "The Origin of Garden Seed." The propagation of various plant groups such as roses, perennials, trees and shrubs, vegetables and herbs, is discussed in detail.

PLANT PROPAGATION IN PICTURES by Montague Free. Published by The American Garden Guild, Inc. and Doubleday & Company, Inc., Garden City, New York, 1957. 251 pp. $4.95.

With photographs far outweighing the text, this book will delight the neophyte gardener. A good basic guide to the propagation of garden plants, trees and shrubs as well as house plants.

PLANT PROPAGATION PRACTICES by James S. Wells. Published by The Macmillan Company, New York, 1955. 344 pp. $7.50.

Highly rated by professionals, this book is up-to-date and complete, covering principles, procedures and special techniques of plant propagation and environmental factors. Nearly twenty choice ornamental plants are highlighted in individual chapters.

THE PROPAGATION OF ALPINES by Lawrence Hills. Published by Farrar, Straus & Cudahy, Inc., New York, 1951. 464 pp. $5.00.

A concise yet comprehensive guide to the propagation of alpine plants, describing most successful methods (seed, division or cuttings) for each species.

VEGETATIVE PROPAGATION edited by John L. Creech. The National Horticultural Magazine, Vol. 33, No. 1, January 1954, 88 pp. $1.00.

A monograph written by a dozen well-known authorities on the subject.

PROPAGATION OF HORTICULTURAL PLANTS by Guy W. Adriance an Fred R. Brison. 2nd edition. Publishe by McGraw-Hill Book Company, Inc New York, 1955. 298 pp. $6.50.

A well-recognized text; specific information emphasizes commercial crops suc as fruits, rather than ornamental plant

PROPAGATION OF ORNAMENTA PLANTS by John V. Watkins. University of Florida Agricultural Extensio Service Bulletin 150, Gainesville, Fla 1952. 56 pp.

Subtropical plants are highlighted i this guide to propagation.

PROPAGATION OF PLANTS by Maurice G. Kains and Leavitt M. McQuester Revised edition. Published by Orange Judd Publishing Company, Inc., Ne York, 1942. 652 pp. $5.00.

A standard textbook covering th principles of plant propagation and including fifty practicums for student us

THE PROPAGATION OF SOM TREES AND SHRUBS BY CUTTING by William L. Doran. Massachusett Agricultural Experiment Station Bulletin 382, University of Massachusetts Amherst, Mass., 1941. 56 pp.

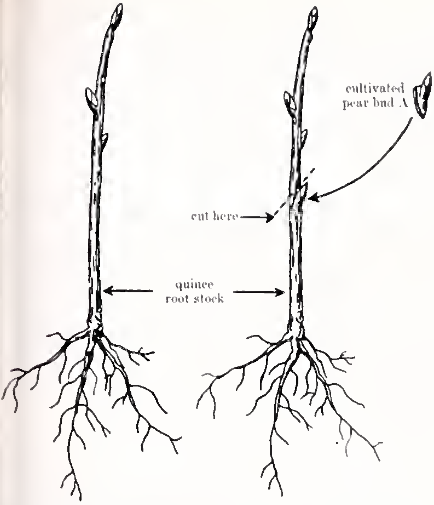
A popular bulletin on rooting cuttings of a wide range of trees an shrubs.

PROPAGATION OF TREES, SHRUB AND CONIFERS by Wilfred G. Shea Published by St. Martin's Press, Inc New York, 1953. 479 pp. $5.00.

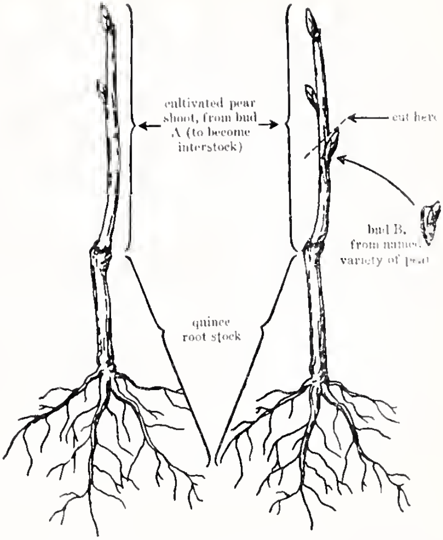
Standard nursery methods of propagating each genus are given, with emphasis on timing and handling.

WOODY-PLANT SEED MANUAL prepared by The Forest Service, U. S. Department of Agriculture. Published b the United States Government Printin Office, Washington, D. C., 1948. 416 p $2.75.

Deals with seed production, collectio storage and treatment for about 15 woody plants.



First step in double budding. Quince-compatible cultivated pear (bud A) is budded to quince rootstock.

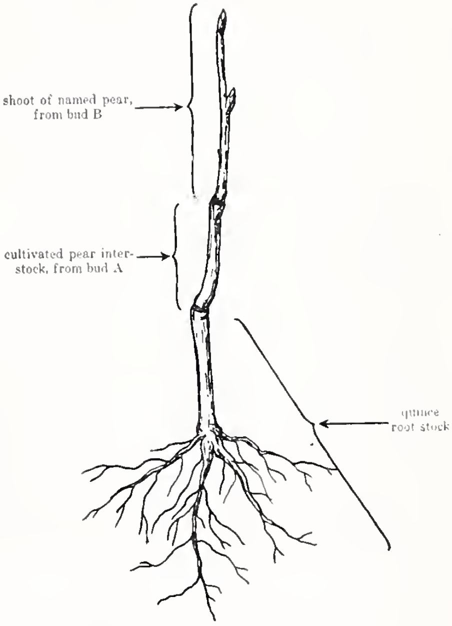

cultivated pear shoot, from bud A (to become interstock)
cut here
bud B, from named variety of pear
quince root stock

Named variety of quince-incompatible pear (bud B) is budded to shoot produced from previous year's budding.

There are East Malling clonal rootstocks of quince; type A from ANGERS quince s usually used. But not all pear varieties will on budding unite with the quince rootstock and particularly BARTLETT, CLAPP'S FAVORITE, and BOSC have poor graft affinity with the quince rootstock. This however can be overcome by so called double budding. A quince-compatible pear variety such as DUCHESSE D'ANGOULEME, BEURRE HARDY, FLEMISH BEAUTY, or OLD HOUSE s budded to the quince rootstock and he following year the quince-incompatible variety is budded 4 to 5 inches high nto the shoot grown from the previous budding. Where quince rootstocks are used, it is best to use budding only since whole scions grafted to quince give very poor survival.

Plum and Prune

A rather wide choice of rootstocks is possible. Most commonly used are seedlings of Myrobalan (cherry plum). Seedlings of the European plum may be used for known horticultural varieties of that species. STANLEY prune and ITALIAN prune may be grown as dwarf trees if budded on seedlings of Bessey cherry.


shoot of named pear, from bud B
cultivated pear interstock, from bud A
quince root stock

Final result, compatible variety serves as interstock between incompatible pear variety and quince rootstock.

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AMONG THE CONTRIBUTORS TO THIS ISSUE

Very early in the preparation of this issue of Plants and Gardens the Editorial Committee came to recognize that in any strict sense it is impossible to select THE 100 Outstanding Trees and Shrubs. Many factors, not the least of which are personal likes and dislikes, enter into such selections. No two persons are likely to agree on *all* the plants that should be included. What has been attempted therefore is to compile a list of plants that are most widely considered to be of high excellence by those who have extensive first-hand knowledge of ornamental plants. The Editorial Committee is deeply indebted to the horticulturists, nurserymen, gardeners and landscape architects who acted as the Selections Committee for this issue, sharing with the Botanic Garden staff their knowledge and experience. The list does not represent the complete choice of any one of them—there are plants listed which a few of the Committeemen would exclude; favorites of a few others have had to be omitted. It does represent a consensus of opinion, based for the most part upon the following criteria which Committee members were asked to consider in making their recommendations.

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Adaptable to various uses in garden or landscape.
Must be available from nurseries, or be reasonably readily obtainable through special sources.

Selections Committee

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Mary Deputy Cattell, Landscape Architect, New York City.

L. C. Chadwick, Professor of Horticulture, Ohio State University, Columbus, Ohio

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PLANTS & GARDENS

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ublished quarterly at 3110 Elm Avenue, Baltimore, Md., by the **Brooklyn Botanic Garden, rooklyn 25, N. Y.** Entered as second-class matter at the post-office at Baltimore, Md., nder act of August 24, 1912. Subscription included in Botanic Garden membership dues. o others: $2.00 per year; $3.75 for two years. Copyright, 1957, by the Brooklyn Botanic Garden.

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Climatic Zone Map 2

Roche

The most beautiful gardens are made with the finest plants.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
BROOKLYN BOTANIC GARDEN
1000 WASHINGTON AVENUE
BROOKLYN 25, NEW YORK
TELEPHONE: MAIN 2-4433

Autumn 1957

About the "Rembrandts" among woody plants:

It is a simple matter to put together a great long list of ornamental trees and shrubs. To evaluate and select the best of them is another question, yet this is the very objective we put before experts in Canada and the United States.

Had the question been to determine 100 magnificent individual specimens, t job would have been easier. But the Committee was charged with the responsibility of deciding on the hundred finest woody species — without regard to individual specimens or where they grow (except for the limitation of temperate or near-temperate climate). Thus hardiness and many of the usual criteria were not part of the consideration, except that purely tropical and near-tropical species were to be omitted. It is to make clear our intent that we have borrowed the now classic name of a great artist and are applying it to trees and shrubs.

In short, we seek to point out the "Rembrandts" of the world of woody plants. For the sake of discussion, and to sharpen the sense of discrimination among gardeners and lay horticulturists, we present this Handbook. The list is not as arbitrary as it may seem to some readers. We welcome letters that will help further evaluations. Please understand that we have discovered many of the difficulties connected with choosing living Rembrandts!

It is a pleasure to express our deep appreciation to members of the Committee for their critical interest and assistance. Whether or not readers completely agree with the list of selections, we hope it will stimulate their interest in knowing a seeking out their own hundred finest and growing at least a few of them to perfection within the limits of their home climate. There are many yet unrecognize treasures in the world of ornamental trees and shrubs, and more people ought to know and grow them.

Sincerely,

George S. Avery Jr.

Director

Rembrandts among the

TREES

As the following pages try to make clear, there are many qualities that can elp to make a "master" among the trees. The over-all form, so subtly determined s growth progresses, gives unmistakable character to a tree. In some, there is an lmost undefinable richness; in others this may be completely lacking. Qualities f bark and leaves, habit of branching and flowering—in rare combinations—can nake a species or variety great. The idea of "specimen trees" for a long time bscured our thinking. The straight, stark tree was "it." We now recognize that nsymmetrical trees have character and beauty equal to and often surpassing that of he strictly symmetrical specimens.

Rembrandt van Rijn, 17th Century master whose paintings are among the world's art treasures.

McFarland photos

Japanese Maple ***Acer palmatum***

Outstanding Features: A fine-textured and graceful tree, with deeply lobed leaves. Some varieties (see list) have a deep red foliage color which persists through the growing season; others have good spring or fall color.

Habit and Use: Small tree, may reach 15 to 20 feet; rounded or mound-like with horizontal branching. Best used as specimen plants or lawn trees. Should not be jammed into shr borders.

Hardiness: Hardy to Zone 5. Native Japan and Korea.

Culture: Tolerates heat or cold but shou be protected from the direct sun esp cially during the early part of t growing season when thin leaves a easily burned by intense sunlig Grows in any reasonably good soi thrives with good drainage. Subje to sun scald in the South and som what susceptible to anthracnose di ease in some areas, especially wh conditions are not ideal.

Varieties of Special Interest:

var. *atropurpureum* (Bloodleaf Jap nese maple) at its best has bea tiful red leaves throughout t season. This variety occasional loses its color when transplante

var. Oshiu-beni has 9-lobed leav which are red in spring but tu green when mature.

var. Burgundy Lace

Care must be used in obtaini these or other varieties of Japane

(Continued on page 236)

* * *

Sugar Maple ***Acer saccharum***

Outstanding Features: Sugar maple is famous for its long life, stately appearance, and the yellow-to-red brilliance of its foliage in autumn.

Habit and Use: As the sugar maple approaches maturity, it is a magnificent tree which may reach 60 to 100 feet in height. An upright, spreading tree, it is usually rounded at the top. One of the best of the larger shade and lawn trees.

Hardiness: Hardy to Zone 3. Native to eastern North America.

Culture: Does best in a rich, well-drained loam, but will tolerate a wide variety of soils.

(The sap from this tree is the one natural source of maple syrup.)

Silk Tree
Albizzia julibrissin rosea

Outstanding Features: The leaves are composed of many small leaflets, hence the delicate, lacy appearance of this tree. For several weeks in mid-summer (and in some specimens until early fall) the tree is covered with round clusters of dainty pink flowers having long stamens that form fluffy balls 1 to 2 inches in diamter. Its foliage and summer bloom are its marks of distinction. Although its life span is fairly short, it begins to bloom at an early age.

Habit and Use: The silk tree is flat-topped and spreading, sometimes with several grayish-colored trunks, generally growing from 15 to 30 feet in height. Foliage casts a light shade. Makes an excellent specimen tree such as for border of lawns, patios, etc.

McFarland

Hardiness: Hardy to Zone 5. Native to Asia.

Culture: Silk tree will grow on almost any soil, and has the special virtue of doing well on poor, dry, rocky soils. Any but smaller specimens are diffi-

(*Continued on page* 236)

Shadbush (Shadblow), Serviceberry
Amelanchier canadensis

Outstanding Features: White flowers in upright clusters in early spring, either before or with the leaves, make this a tree of special interest. Its leaves are silver-gray as they unfold during early growth.

Habit and Use: The shadbush ranges in size from a shrub or small tree up to about 30 feet in height. It is rounded at the top, and more or less elliptic in outline. It is a desirable ornamental tree for use at the edge of a lawn or in the border. Its purple fruits in summer are well liked by birds.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: The shadbush does best in a well drained, loamy soil, but is tolerant of varied soil conditions. It is relatively free of pests and diseases, but is occasionally attacked by fire blight.

Other Species: Other kinds of *Amelanchier* have appeal and are well worthy of investigation before purchase.

Roche

Gottscho-Schleisner

Canoe Birch or Paper Birch
Betula papyrifera

Outstanding Features: Its unique white bark, and brilliant yellow foliage in autumn make this an outstanding tree.

Habit and Use: Canoe birch is a tal tree occasionally reaching 80 to 9 feet with a rounded crown and numerous large horizontal branches The twigs are slender and droo slightly, giving the tree a very graceful appearance. The interesting bark white in color, peels in thin sheets as the tree grows in diameter. It offers a dramatic appearance i planted near the border of a lawn.

Hardiness: Hardy to Zone 2. Native to northern North America.

Culture: This birch prefers a moist, slightly acid, light soil but will do well with greater fertility. It is subject to canker, which can best be prevented by keeping trees in vigorous health and removing dead or diseased branches. The birch leaf miner is in some localities an annoying pest which leads to fall of leaves in early summer, but new foliage soon appears.

Other Birches: The European weeping birch (*Betula pendula*) is a handsome tree, but often dies back at the

(*Continued on page* 236)

* * *

Katsura Tree
Cercidiphyllum japonicum

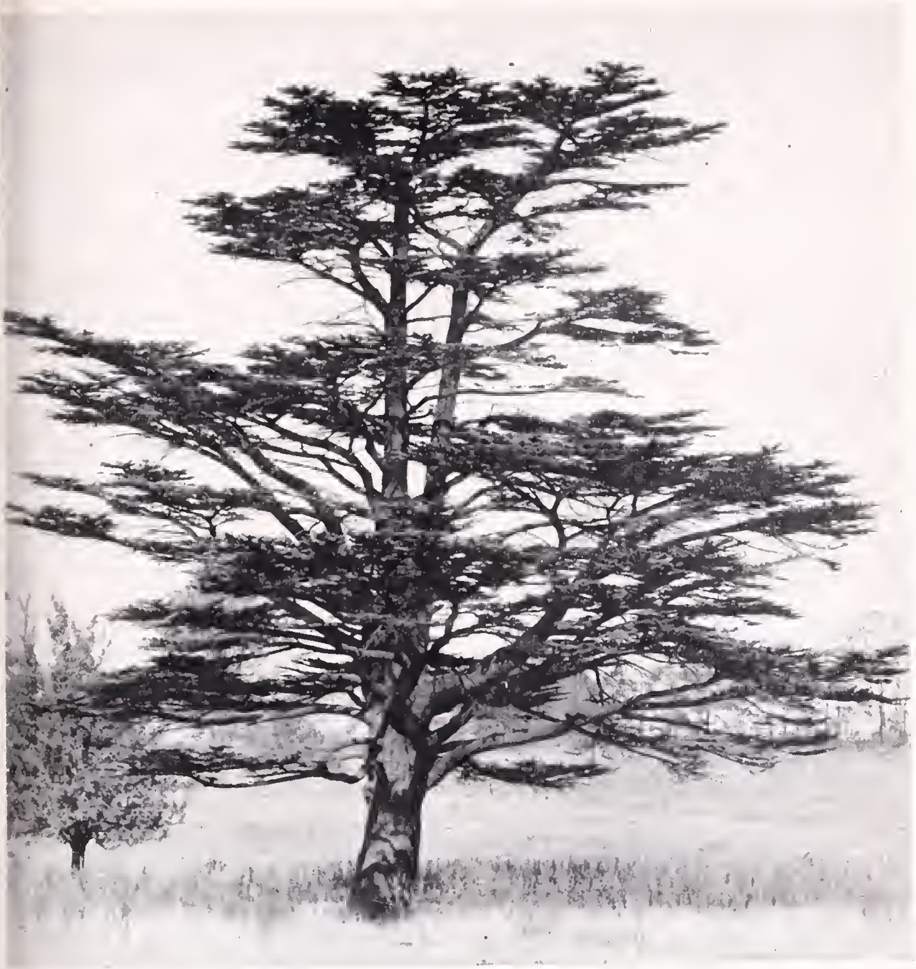
Outstanding Features: The excellence of its pest- and disease-free foliage and its interesting branching habit make this tree worthy of high rating.

Habit and Use: The Katsura tree is virtually unique in its growth, having numerous upward-branching trunks, somewhat like the American elm. If allowed to grow with only one trunk, it becomes columnar in habit. Where there is ample space for it to grow, it will ultimately reach a height of 60 or more feet, and have as great a spread.

Hardiness: Hardy to Zone 4. Native to Japan.

Culture: Does best in fertile, rich, moist soil.

Buhl



Cedar of Lebanon *Buhle*

Atlas Cedar ***Cedrus atlantica***

Outstanding Features: Picturesque growth habit makes this one of the world's most interesting evergreen trees. Clumps of short needles on twiggy branches leave the trunk (or trunks) open to view at all seasons.

Habit and Use: Broadly pyramidal in growth, ultimately reaching a height of 100 feet or more. With maturity it becomes somewhat flat-topped. Rich in "character", it is best used as a specimen tree where there is adequate room for its growth.

Hardiness: Hardy to Zone 6. Native to North Africa.

Culture: Atlas cedars grow satisfactorily in a well drained loam or clay loam. They withstand wind and drought, but cannot stand boggy soils.

Varieties of Special Interest: Best known is the variety *glauca.* The somewhat bluish tinge of the needles of this variety give it interest and individuality. The variety *pendula,* a weeping form, deserves to be better known.

* * *

Cedar of Lebanon ***Cedrus libani***

Difficult to distinguish from Atlas Cedar. See Atlas Cedar for growth habit, culture, etc.

Roche

Redbud in flower

Eastern Redbud

Cercis canadensis

Outstanding Features: Before the leaves come out in spring the branches and twigs are covered with small, purplish-pink, pea-like flowers; the color blends well only with yellow and white. The moderately large, heart-shaped leaves give a bold effect.

Habit and Use: Small, irregular tree or shrub sometimes reaching 30 feet or more, but usually considerably less. Can be used as specimen tree, but is better in woodland plantings.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Does best in nearly neutral or somewhat acid, well-drained soil. Easy to transplant when young but difficult when older.

Other Kinds:

var. *alba* has white flowers.

The Chinese redbud (*Cercis chinensis*) is less hardy than *C. canadensis*, being dependable only to Zone 6 Its flowers are about the same colo as those of eastern redbud but ar borne so densely as to completel hide the twigs themselves. In Central China, its home, it may becom a substantial tree, but in the Unite States it usually has a shrubby habit

Redbud blossoms

McFarlan

ellow-wood *Cladrastis lutea*

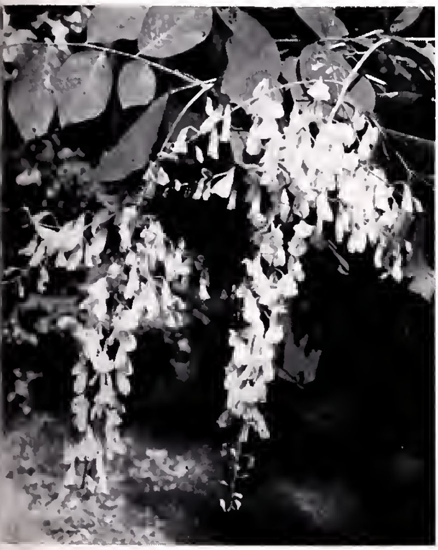
utstanding Features: Yellow-wood has attractive, dense foliage and unusual, beautifully smooth gray bark. In late spring or early summer it produces hanging clusters of white, fragrant flowers resembling those of a white wisteria. In fall the foliage turns rich yellow.

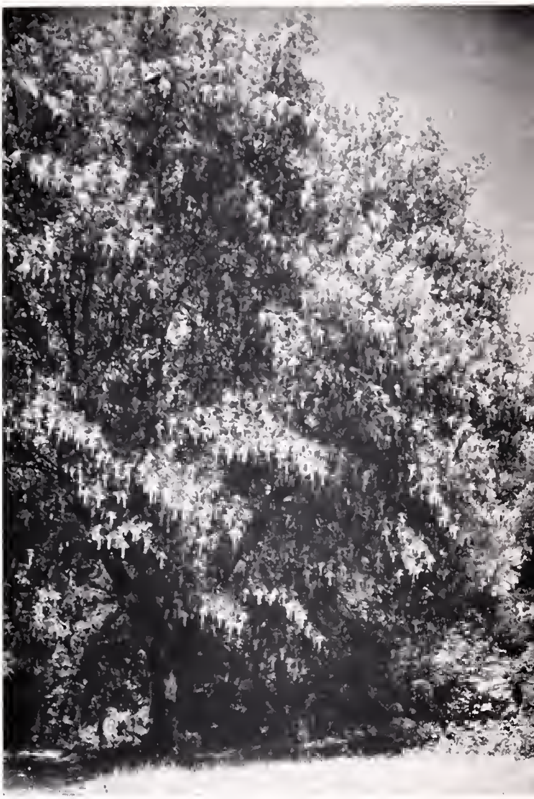
abit and Use: Generally rounded in form, growing to 40 or 50 feet. An excellent specimen tree. Has a tendency to develop weak crotches. Flowers are sometimes borne only every two or three years.

ardiness: Hardy to Zone 3, that is, practically throughout the United States. Native to southeastern United States.

ulture: This tree will stand extremes of heat and cold as well as drought. Should have a sunny location. While tolerant of varied soil conditions, thrives in deep rich soil. Foliage may burn in localities with insufficient rainfall or soil water. It is relatively free from pests and diseases. If pruning is necessary it should be performed in summer or autumn rather than in spring, to avoid excessive loss of sap.

Yellow-wood blossoms *McFarland*

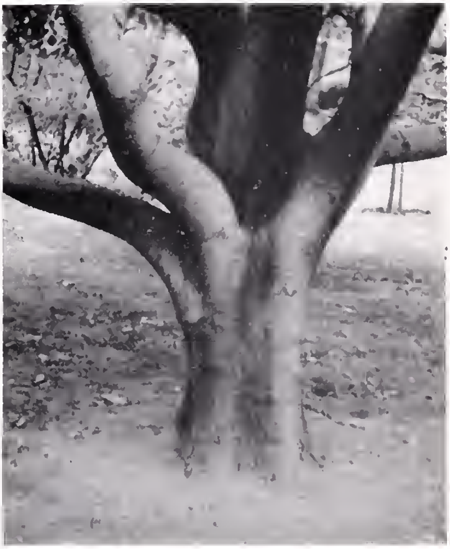




McFarland

Yellow-wood in bloom

Trunk of yellow-wood *Nelson*

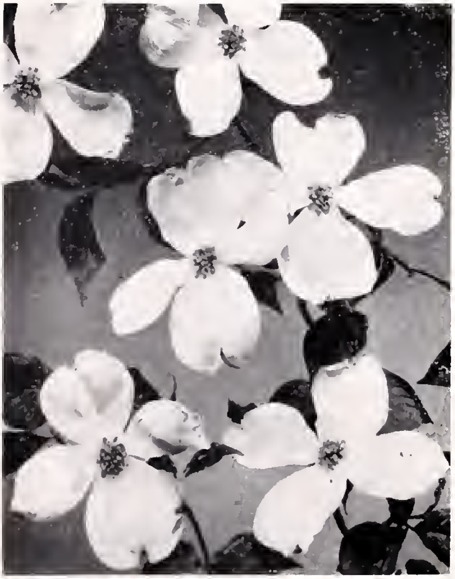


Flowering dogwood *McFarlan*

Flowering Dogwood
Cornus florida

Outstanding Features: Flowering dogwood has beauty every season of the year. It is most famous for its spring display of showy white-bracted "blossoms" that come out before the leaves. In fall it again becomes brilliant when its leave take on colorful hues of purple an red, and its berry-like fruits ripe to a brilliant shiny red. In winte the branches make a fine patter the twigs tipped with next season' flattened flower buds.

Blossoms of flowering dogwood *Roche*



Habit and Use: Small, flat-topped tre 10 to 30 feet tall; branches in horizontal tiers. A handsome ornamental tree for use as a small specimen tree near the edges of lawns o in gardens—especially in light shad under tall trees, in shrub borders and against wooded background (particularly against pines).

Hardiness: Hardy to Zone 4. Native t eastern and southern United State

Culture: Does well from northern Florida to southern Maine. Tolerates wide variety of well drained soils does best in light, acid soils, whethe fertile or poor. Will grow in su or shade, but partial shade is bette in warmer climates. It is attacke by dogwood borer which eats sof tissue under the bark, frequentl girdling entire branches or even th main trunk. This pest is difficult t

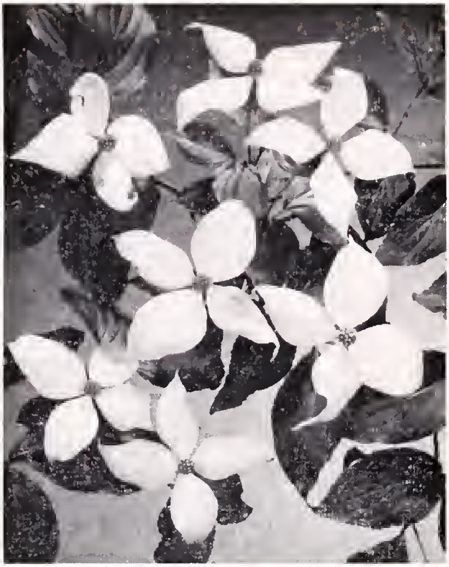
(*Continued on page* 236)

Kousa Dogwood *Cornus kousa*

Outstanding Features: Flower clusters are similar to those of flowering dogwood, but the bracts are pointed, giving the blossoms a markedly different, star-like appearance. They are produced in early summer after the leaves are out and are said to be more attractive when viewed from a point slightly higher than the tree itself. Fall color of the foliage ranges from scarlet to purple. The fruits hang on slender stems and from a distance resemble strawberries.

Habit and Use: Small tree, when young somewhat more upright than *Cornus florida* but becoming quite spreading with age. Leaves are narrower than those of flowering dogwood, giving the tree a more delicate appearance. Grows 20 to 25 feet tall. Can be used in same way as flowering dogwood, as specimen plant or in shrub borders.

Hardiness: Hardy to Zone 5. Native to Japan and China.



Kousa dogwood flowers *Roche*

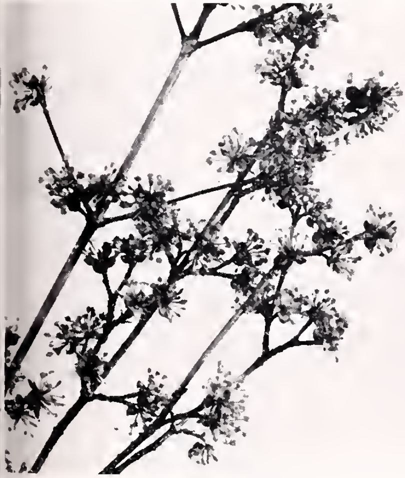
Culture: About the same as for flowering dogwood; must have light, well drained soil for best development.

Varieties:

var. *chinensis* has somewhat larger flowers than the species.

* * *

McFarland



Cornelian-cherry

Cornelian-cherry *Cornus mas*

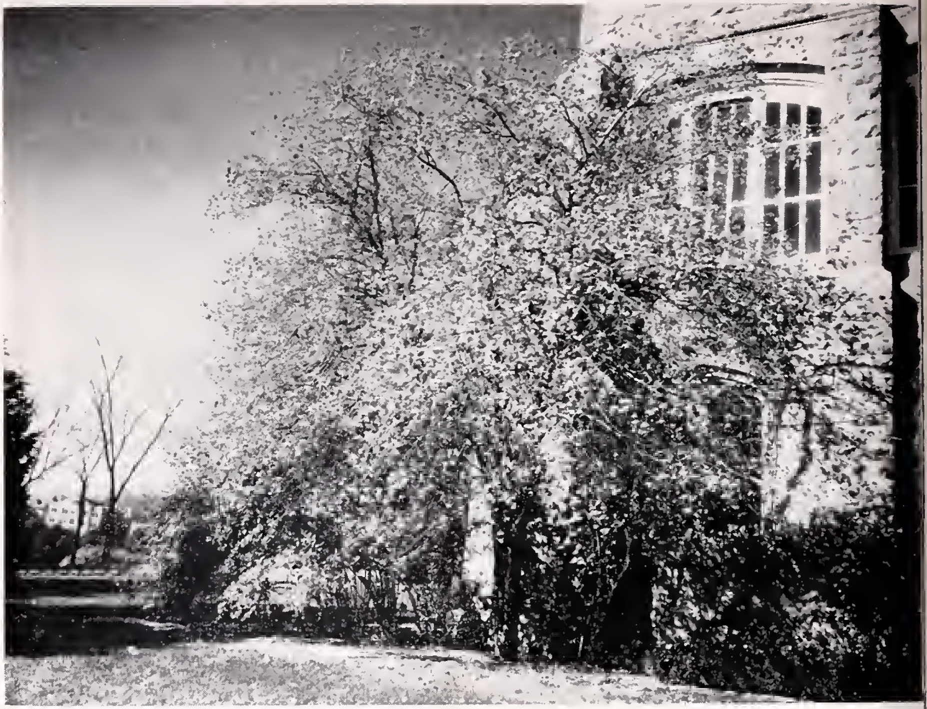
Outstanding Features: One of the first plants to bloom in spring, when it is covered with round clusters of minute yellow flowers before the leaves appear. The fruit, resembling a scarlet, oval cherry, ripens in late summer or early fall.

Habit and Use: Rounded, dense-growing tree, often shrub-like. May ultimately attain a height of more than 20 feet. Useful as a specimen plant and handsome in border plantings.

Hardiness: Hardy to Zone 4. Native to southern Europe and Asia.

Culture: Similar to that of other dogwoods. The cornelian cherry is free from pests and diseases.

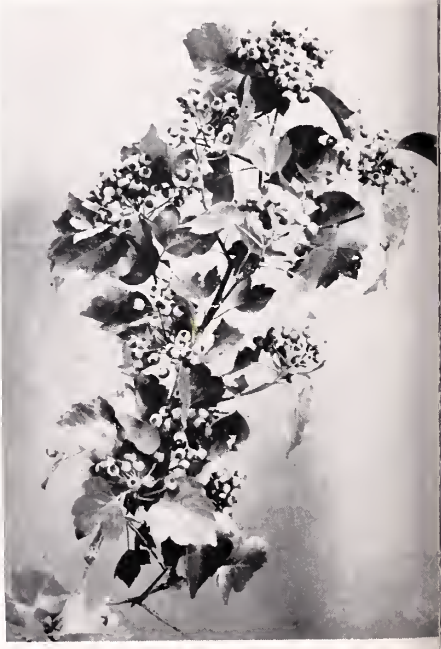
Cornus officinalis is very similar but flower clusters are larger and some consider it a better species than *C. mas.*



Washington thorn *McFarland photo*

Washington Thorn
Crataegus phaenopyrum

Fruit of Washington thorn



Outstanding Features: This tree, widely regarded as the best of the hawthorns, is of interest at all seasons. The foliage is dense and lustrous, turning orange or scarlet in fall. The flowers are white, borne in clusters in early summer. The small bright red fruits remain attractive throughout the winter.

Habit and Use: Dense, upright tree to 30 feet high. Useful as a specimen tree planted near the edge of a lawn, also valuable along highways.

Hardiness: Hardy to Zone 4. Native to southeastern United States.

Culture: Washington thorn grows well in rich, well drained sandy loam; will tolerate alkaline conditions and drought. Thrives where winters are fairly cold and dry; for this reason may not reach best development in coastal areas although it will grow there. Needs full sun.

English hawthorn *Roche*

English Hawthorn
Crataegus oxycantha

Outstanding Features: Attractive in habit, the English hawthorn is best known for its flowers. The species has white flowers, but the pink and red flowered varieties are of greatest interest. The dense, rather fine-textured foliage gives the plant distinct character. The red fruit is colorful in the fall.

Habit and Use: Dense, thorny, rounded tree to 15 or 20 feet or more. Useful as a specimen tree, particularly if planted near the edge of a lawn. Can be used in hedges. Fails to develop autumn foliage color.

Hardiness: To Zone 4. Native to Europe and North Africa.

Culture: English hawthorn has about the same growing requirements as the Washington thorn. It is subject to fireblight and to woolly aphis and, periodically, considerable care may be necessary to combat these.

Varieties:

var. *coccinea* has crimson flowers.

var. *pauli* (Paul's Scarlet) is a double red-flowered variety, generally regarded as the showiest of the hawthorns.

var. *plena* has double white flowers.

* * *

Cockspur Thorn
Crataegus crus-galli

Outstanding Features: White flowers are borne in clusters in late spring, followed by red fruit which are effective most of the winter. Foliage is lustrous, turning orange or red in fall.

Habit and Use: Round-headed tree which may grow to more than 30 feet. The thorny branches often have a definite flat, spreading form which makes it a striking specimen plant. It can be sheared to make a fine hedge.

Hardiness: Hardy to Zone 4. Native to eastern North America.

Culture: Much the same as for the other thorns.

Variety:

var. *splendens* has very glossy leaves.

Buhle

Russian-olive
Elaeagnus angustifolia

Outstanding Features: Russian olive is prized for its silver-gray foliage. The crooked trunk and branches give it character. The shedding bark is also of interest, especially in winter.

Habit and Use: Grows 15 to 20 feet in height. Useful in backgrounds of large shrub borders and for seasid plantings. Small yellowish flower in June are followed by yellowis fruit with silver coating.

Hardiness: Hardy to Zone 2. Native t Europe and western Asia.

Culture: Can be grown in many kind of soil but does best in light, sand loam. Withstands seacoast conditions.

(*Continued on page* 236

* * *

Franklinia ***Franklinia alatamaha***

Outstanding Features: Notable for its beautiful white flowers (up to 3 inches across) with yellow stamens in center. Blooms in late summer or early fall, when other flowering trees are through for the season. The glossy green leaves, up to 6 inches long, turn orange-red in autumn.

Habit and Use: Erect, upright tree to about 20 feet. Useful chiefly as a specimen tree.

Hardiness: Hardy to Zone 6.

Culture: Franklinia is a native of the southeastern United States but is now known only in cultivation. It does well in moist but well drained soils, but also can be used along river banks. Not always easy to establish.

Roch

Buhle

American Beech *Fagus grandifolia*

Outstanding Features: Dense, rich green foliage and beautiful light gray bark combined with its excellent growth habit make American beech outstanding winter or summer. Autumn foliage color ranges from clear yellow to golden-bronze.

Habit and Use: Densely pyramidal tree growing to 90 feet or more. Requires considerable growing space, so is not appropriate for mixed ornamental plantings in limited areas.

Hardiness: Hardy to Zone 3. Native to eastern North America.

Culture: Does best in rich, light loam. Does not withstand city conditions well.

* * *

European Beech *Fagus sylvatica*

Outstanding Features: In addition to its varying but superb growth habits, European beech has dense, glossy foliage and striking smooth, gray bark. Leaves of the green-foliaged form turn bronze in fall. A few select varieties are listed below.

Habit and Use: Most varieties of this species ultimately grow to be very large trees of 90 feet or more. They are highly prized as specimen plants. Need ample growing space.

Hardiness: Hardy to Zone 4. Native to Europe.

Culture: Beeches do best in a deep, rich, light loam that is well-drained. The roots are fibrous, and feed heavily near the surface so it is difficult for anything else to grow under beeches. The trees do not withstand city conditions well, or having the surface soil compacted about the roots. Relatively free from diseases.

Varieties: There are many varieties of European beech. Among them are: Purple beech (var. *atropunicea*),

(*Continued on page* 236)

U. S. Forest Serv

Buhle

Ginkgo or Maidenhair Tree
Ginkgo biloba

Outstanding Features: Ginkgo, one o the most ancient of living species o trees, is prized for its picturesqu growth habit and its beautiful ligh green, fan-shaped leaves. The latte resemble in pattern the leaflets o maiden-hair fern, hence the commo name of this tree. The foliage turn yellow in autumn.

Habit and Use: Large tree, ultimatel growing to more than 100 feet Branching is often irregular, an conspicuously spreading in old specimens. Interesting as specimen trees Only male plants should be used because of the obnoxious odor of th ripe and decaying fruits produce by female plants.

Hardiness: Hardy to Zone 4. Native t China.

Culture: Ginkgo tolerates a wide variet

(Continued on page 237)

Honey-locust
Gleditsia triacanthos

Outstanding Features: Valued chiefly for its attractive growth habit and its delicate light green, lacy foliage. It is an excellent tree for light shade. The small greenish inconspicuous flowers produce the twisted 12-18 inch long pods that persist after leaf-fall. These have some ornamental value but may be a nuisance because of the litter they cause.

Habit and Use: Open-growing, spreading top, in shape much like the American elm. Grows to 100 feet or more. Excellent for many uses. The thornless varieties are generally recommended as a substitute for elm. Tolerates city conditions.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Honey-locust is easy to grow, withstands drought, sun, smoke, and is not particular as to soil, but does best in slightly alkaline soils. It is relatively free from pests and diseases but is sometimes attacked by borers.

Varieties: The Moraine locust (var. *inermis* MORAINE) has a beautiful vase shape when young, and is believed to be sterile, since it rarely produces pods. It has the further advantage of being thornless, as are some other varieties. Also good varieties are IMPERIAL and SKYLINE.

Buhle

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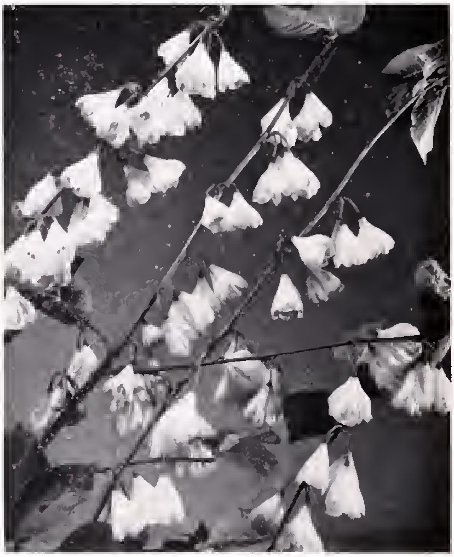
Carolina Silverbell
Halesia carolina



Roche

Outstanding Features: One of the most interesting spring-flowering trees. Its branches are hung with many small, pendent white flowers, giving it a delicately beautiful appearance. The leaves turn yellow in fall.

Habit and Use: Spreading loose shrub or small tree, ultimately reaching about 20 feet in height. Used most satisfactorily as a lawn specimen, or in light woodland plantings.

Hardiness: Hardy to Zone 4. Native to southeastern United States.

Culture: Silverbell does best in a rich moist loam which is reasonably well drained. Should be grown in partial shade and needs protection from

(*Continued on page* 237)

McFarland

Goldenrain Tree
Kolreuteria paniculat

Outstanding Features: In early summe the goldenrain tree is covered wit large, showy clusters of small bright yellow flowers. These ar followed by conspicuous bladder-lik pods that are handsome in autumn No autumn foliage color in most localities. Bark and tortuous branche give winter interest.

Habit and Use: Tree of flat-topped compact habit with twistin branches, growing to more than 3 feet. Best planted near edge o lawn as a specimen tree, or in woodland border. Is sometimes used a a street tree, but as the wood i rather weak, its use for this purpos

(*Continued on page* 237)

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Witch-hazel ***Hamamelis* species**

Outstanding Features: The unique little flowers, yellow or in some species reddish, appear in late autumn or early spring when the leaves are off. Leaves of most are bright yellow in autumn.

Habit and Use: The witch-hazels are small trees, often rather shrubby and sprawling in habit, reaching 20 or more feet in height. They are best used in woodland border plantings o as background specimens wher their unusual blossoms can show of to advantage.

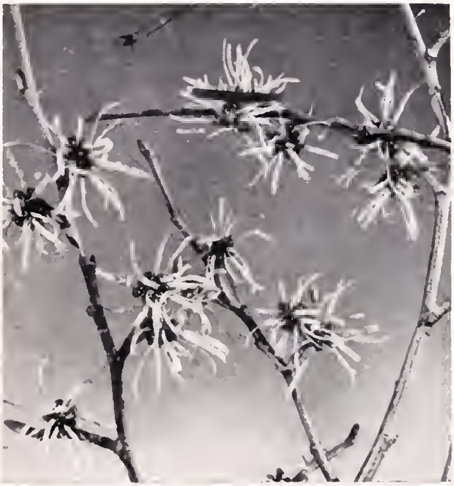
Hardiness: Hardy to Zone 5. Native t China (*H. mollis*) and Nort America.

Culture: Not demanding as to soil, bu do best in a light woodland situation

Species: Chinese witch-hazel (*H. mollis*)

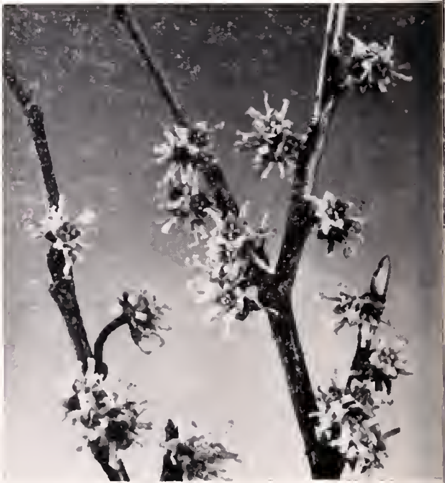
(*Continued on page* 236)

Blossoms of Chinese witch-hazel



Blossoms of vernal witch-hazel

Roch



McFarlan

English Holly ***Ilex aquifolium***

Outstanding Features: English holly is prized for its beautiful dark green, glossy foliage which it holds throughout the year, and its brilliant red berries in fall and early winter.

Habit and Use: A pyramidal tree reaching 40 or more feet in height when mature and allowed to develop freely. Can be trimmed for medium or large hedges, or grown as lawn or specimen trees. Male plants make the best hedges.

Hardiness: Hardy to Zone 6. Individual seedlings often vary widely in hardiness, and some clones will withstand winters well into Zone 5, if planted in well drained, wind-free situations with winter shade. Interested gardeners in Zone 5 (and even Zone 4) might find experimenting with English holly interesting and rewarding. (Also see PLANTS & GARDENS, Autumn 1956, pages 244 to 247.) Native to Europe and Asia.

Culture: English holly does best in moist climates and in either acid or neutral soils. Somewhat sandy, rich, well drained soils are ideal. Partial shade is recommended, but for best

(*Continued on page* 237)

Roche

U. S. Forest Service

American Holly ***Ilex opac***

Outstanding Features: Evergreen fol age and red berries in late fall an early winter. While the foliage lack the lustrous quality of English holl this is a splendid species.

Habit and Use: Tree grows to 50 fe or more. There is great variatio among the varieties of America holly. In general the leaves ar lighter green in color and not a glossy as those of English holly, bu varieties have been selected whic almost equal the English holly i these respects. Like English holl American holly makes a super specimen tree if planted near th edge of a lawn, or it can be trimme for hedges. Male plants make more uniform and attractive hedge.

Hardiness: Hardy to Zone 6, and som varieties in Zones 4 and 5 if specia attention is given to planting location (see comment under Englis holly). Generally regarded a littl hardier than English holly. Native t eastern and southern United States

Culture: American holly grows best i light sandy soils, moist but wel drained. Water-logging can caus wilting of the foliage. Exposur should be the same as for Englis holly—sun in summer, but protection from winter sun and wind American holly tolerates seaside conditions well. Mulching prevents drying out of the roots and reduce need for cultivation. Do not over fertilize. If new spring growth i pale and weak, indicating lack o nutrients, a handful or two of complete fertilizer can be applied in ring around the plant and worke into the soil in late winter or ver early spring. Do not apply fertilize in late summer or fall; it will stimulate late growth of tender shoot which winter-kill.

Varieties: Numerous, but for the mos part not yet adequately tested. Trus your nurseryman, at least unti more information is available.

Goldenchain Tree, Waterer Laburnum *Laburnum watereri*

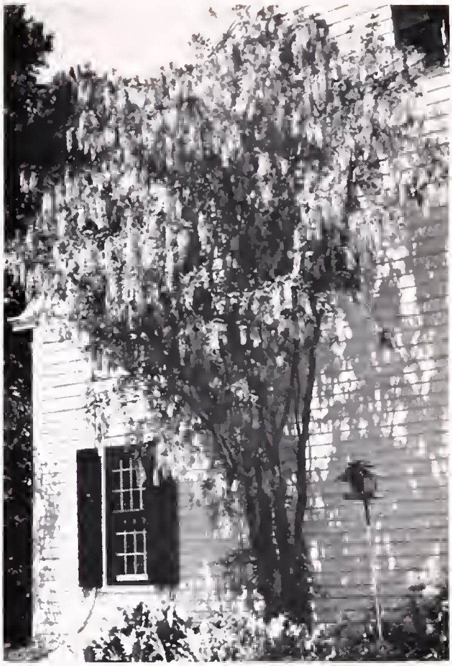
Outstanding Features: Notable primarily for its magnificent early summer bloom. Bears abundant pendulous clusters of bright yellow pea-like flowers.

Habit and Use: Upright-growing, rather stiff and shrubby tree, ultimately reaching 30 feet. Best used as a specimen tree on edge of lawn area, also lends itself to espaliering.

Hardiness: Hardy to Zone 5. Hybrid, parents native to central and southern Europe.

Culture: Tolerates a wide variety of soils, does best in moist soils with limestone base. Will grow in sun or shade, but is better in light shade as the foliage may burn in full sun. Relatively free from pests and diseases.

Laburnum watereri is a hybrid between *L. anagyroides* and *L. alpinum*. It is more satisfactory than either parent, although *L. alpinum* is hardier—to Zone 4.



Roche

* * *

Crape-myrtle *Lagerstroemia indica*

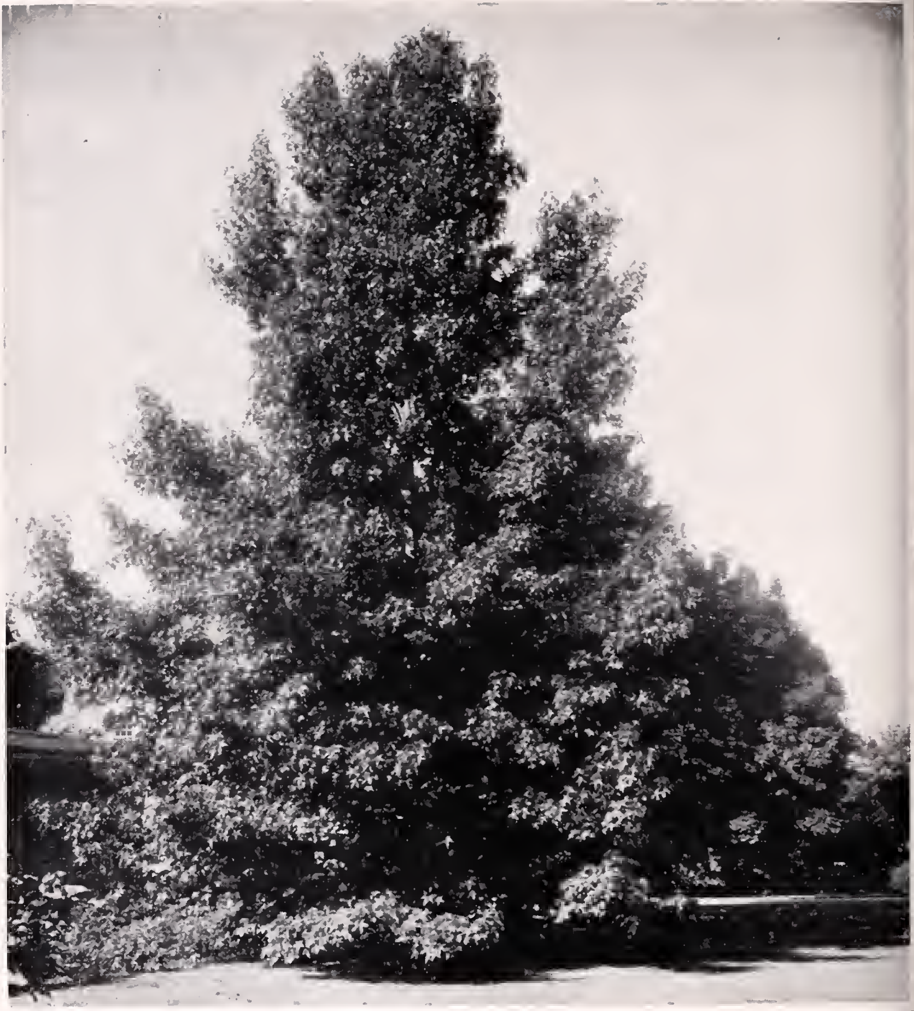
Outstanding Features: The abundant and almost lilac-like flower clusters which continue their bloom through late summer and into early fall, make this a justly famous plant. In the species the flowers are pink to red, but there are varieties having white, purple, lavender and bluish flowers as well.

Habit and Use: Small, shrubby tree reaching 25 feet in the South; more shrub-like northward. Widely used throughout the South as a lawn or accent plant and for large hedges; useful as tub plant in the North.

Hardiness: Hardy to Zone 7. Crape-myrtle is reliably hardy as far north as Baltimore, and is growing successfully at the Brooklyn Botanic Garden and in sheltered spots eastward to Cape Cod. Worth experimenting with in protected places north of usual range. Native to China.

Culture: Grows best in hot, dry climate, and in fertile, well drained loam, but will tolerate a wide range of soils. Winter or year-round mulch is desirable in colder parts of its range. Plant in open sun. Flowers are borne on the current season's growth so may be pruned severely if needed to make a compact plant. Difficult to transplant except when small.

Nelson



McFarland

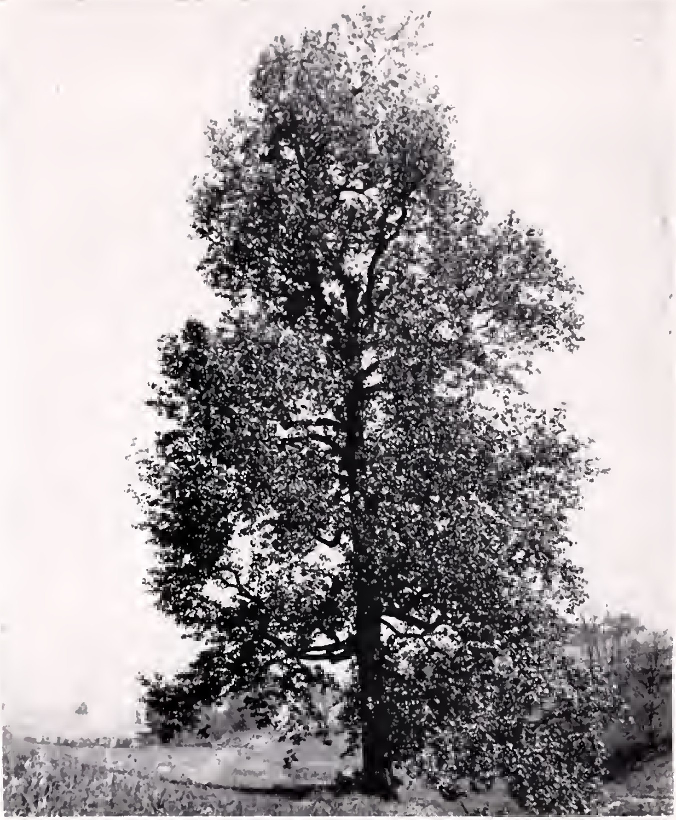
Sweet-gum
Liquidambar styraciflua

Outstanding Features: Sweet-gum is noted for its beautiful symmetry and star-shaped leaves which turn brilliant red, orange and yellow in autumn, the display being especially vivid where winters are cold. The bur-like fruits are conspicuous on the tree after the leaves fall.

Habit and Use: Tall, symmetrical tree of broad pyramidal habit, ultimately reaching more than 100 feet in height. Excellent specimen or lawn tree if given ample space for development; also useful along highways.

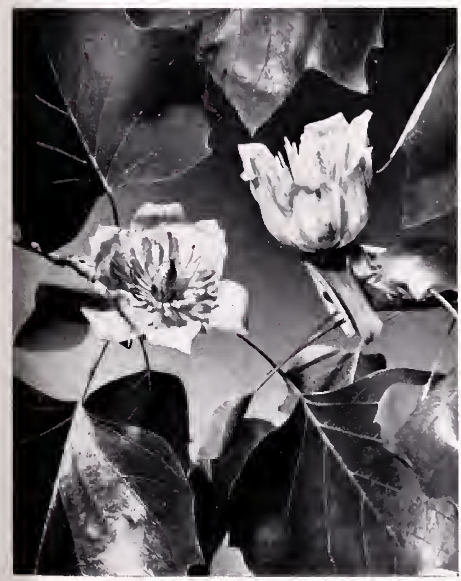
Hardiness: Hardy to Zone 4. Native to eastern and southern United States and Mexico.

Culture: Sweet-gum is adaptable, even to seacoast conditions. Will tolerate a wide range of soil conditions, but does best in a deep, rich loam. Grows well in sun or in partial shade, but will not tolerate full shade. Should be severely pruned when transplanted. Comparatively free of pests and diseases.



McFarland

Roche



Tulip Tree
Liriodendron tulipifera

Outstanding Features: An impressive specimen of this tree is never forgotten (nor is its simple but beautiful leaf shape). It gets its name from its flowers, 2 inches or more across, tulip-shaped, greenish-yellow with an orange band. They appear in early summer. The foliage turns a brilliant yellow in autumn.

Habit and Use: A pyramidal tree which may grow to enormous size, well over 100 feet in height. It makes a fine specimen tree in situations where it has room to develop, but is not for small gardens. A fine old grove is to be seen in the gardens of the Winterthur Museum near Wilmington, Delaware.

(*Continued on page* 237)

McFarland

Southern Magnolia
Magnolia grandiflora

Outstanding Features: A magnificent tree, justly famous for its large, glossy, evergreen leaves, its symmetrical habit and its huge (up to 8 inches across) fragrant white flowers which in cooler climates are borne in early mid-summer.

Habit and Use: A dense, symmetrical tree growing to 80 or 90 feet in height. It has wide-spreading branches and makes a fine specimen tree if given ample room for development. It casts a very heavy shade.

Hardiness: Hardy to Zone 7, individual specimens in sheltered locations to Zone 6. Native to southern United States.

Culture: Thrives in a hot, humid climate, will tolerate some cold but not prolonged freezing. A few old speci-

(*Continued on page* 238)

Saucer Magnolia
Magnolia soulangeana

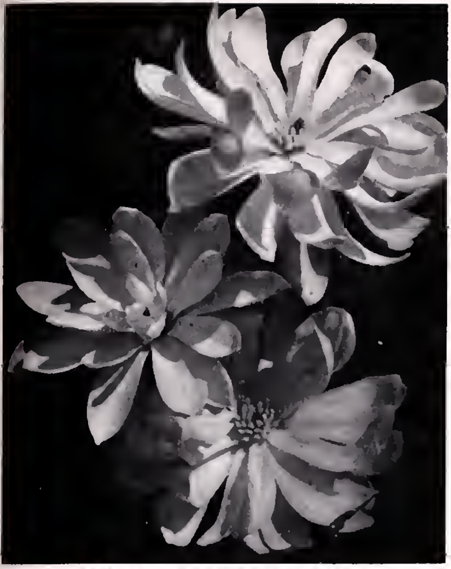
Outstanding Features: Best known for its display of large showy flowers in early spring. Flowers precede the leaves and nearly cover the tree; they are 5 to 10 inches across, and range (in the different varieties) from white through many shades of pink to purple. Even small plants but a few feet tall will bloom. The light gray bark of trunk and branches is attractive in winter, especially when the trees are planted against an evergreen background.

Habit and Use: Often has several trunks and rather shrub-like habit. May ultimately attain a height of 20 feet or more. Valuable as a specimen tree in a location where it can be seen at a distance, and will not be too conspicuous after the blooming season, as the foliage is coarse. Does well under city conditions.

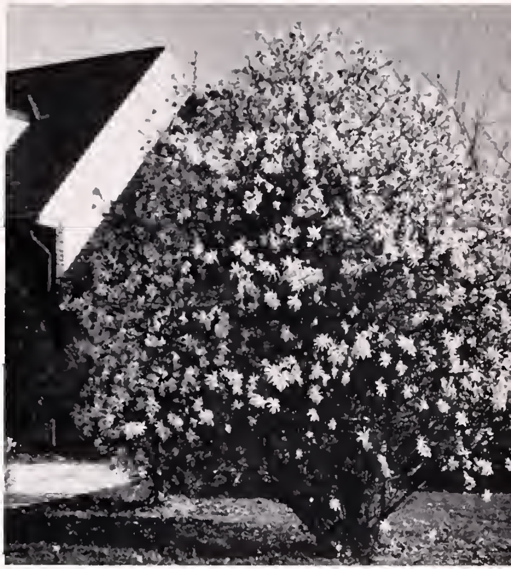
Hardiness: Hardy to Zone 5; can be

(*Continued on page* 237)

U. S. Forest Service



Blossoms of star magnolia



McFarland pho

Star Magnolia ***Magnolia stellata***

Outstanding Features: Earliest of the magnolias to bloom in temperate climates. Attractive star-like, chalky-white flowers, more or less double, with many narrow petals; they appear before the leaves. In winter the light colored bark, twiggy branches, and the silky, olive-green flower buds at the tips of twigs have considerable ornamental value.

Habit and Use: Shrub or small tree, densely branching and rounded in outline. The leaves are smaller than those of most magnolias, hence the attractive, less coarse texture of this species. Useful as a specimen shrub, as accents in shrub borders, or in groupings.

Hardiness: Hardy to Zone 5. In the northern parts of its range the blossoms are often nipped by late frosts or spoiled by early spring winds and rainstorms. Native to Japan.

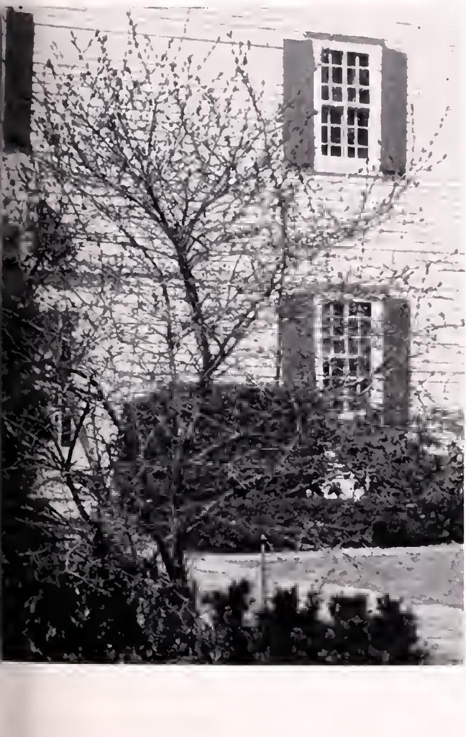
Culture: Thrives in fertile, moist soil in sun or shade, but tolerant of a wide range of soil conditions. Withstands city conditions well.

Variety:

var. *rosea* has pale pink flowers.

Star magnolia in winter

Roche



McFarland

Flowering Crab-apple ***Malus* species**

The flowering crab-apples are prized among ornamental trees for their great floral display in spring, and their attractive fruit in autumn and early winter. The intricate growth pattern of trunk and main branches of many varieties provides outstanding winter interest.

The four kinds described here are excellent but there are many other splendid crab-apples. Consult your nurseryman about the relative desirability of the great number of outstanding varieties available in a wide range of flower color, time of flowering, and fruit size and color.

Crab-apples will grow well in almost any well drained soil whether poor or fertile.

Japanese Flowering Crab-apple ***Malus floribunda***

Outstanding Features: The buds of the Japanese flowering crab-apple are deep pink or red, the flowers quickly fade to white. They are 1 to 1½ inches in diameter, fragrant, and borne in great profusion in May. The small yellow or red fruits are attractive from late summer well into the fall.

Habit and Use: Trees of this species are of medium stature—reaching 30

(*Continued on page* 238)

Arnold Crab-apple ***Malus arnoldiana***

Outstanding Features: One of the most attractive species. The buds are rose-red, the blossoms pink outside, fading to white on the inside. They are produced in spring. The fruit, about ½ to ⅝ inch in diameter, is yellow and red and makes an effective display in early fall.

Habit and Use: Tree to 20 feet, densely branching and mounded. Best used for specimen tree or in groups.

Hardiness: Hardy to Zone 4.

McFarland

Sargent's Crab-apple
Malus sargenti

Outstanding Features: One of the "gems" of the small-sized crab-apples. The flowers are pure white, fragrant and completely cover the plant in spring. The small, dark red fruits color before the leaves fall and last well into the autumn. The foliage may show rather good orange autumn color, and the short trunk and twisting side branches provide winter interest.

Habit and Use: Low growing and spreading, forming a dense mound 6 to 8 feet high and equally as broad. An excellent crab-apple for small properties.

Hardiness: Hardy to Zone 5. Native to China.

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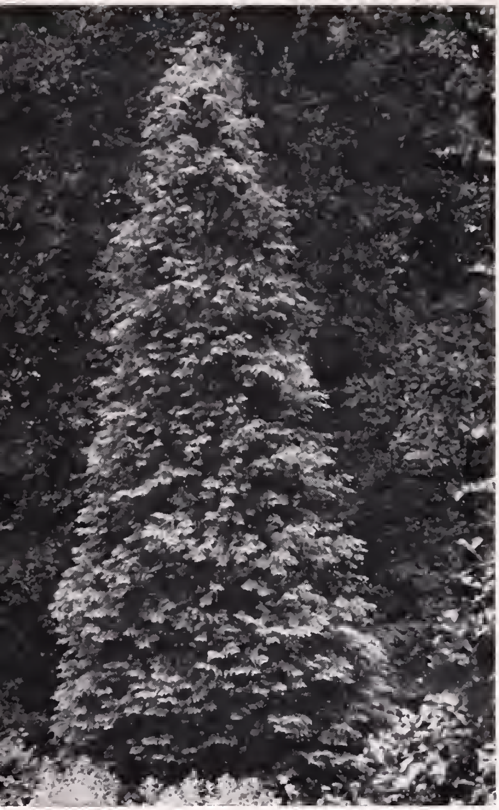
Red Jade Crab-apple
Malus RED JADE

Outstanding Features: The long, pendulous to semi-pendulous branches of RED JADE and the small, bright red, cherry-like fruits make it an outstanding weeping crab-apple. Its irregular trunk and branching habit give it unusual character. At an early age, in spring, it is covered with an abundance of small flowers, pinkish outside, white inside. These are followed in the fall by multitudes of shining fruits borne along the drooping branches.

Habit and Use: RED JADE is a small tree reaching about 15 feet at 25 years of age, and of medium to strong weeping habit. Excellent specimen or tub tree.

Hardiness: Hardy to Zone 4.

Schaefer



Buhle

Dawn-redwood
Metasequoia glyptostroboides

Outstanding Features: Many more years of testing will be required before the real qualities of this newly discovered "living fossil" can be evaluated. Found in 1945 in China, and introduced in 1948, it promises to have some of the ornamental qualities previously available in no one species. In foliage character it somewhat resembles the deciduous bald cypress, but its flat needles are nearer the size of the redwood and the hemlock. In its first ten years, its pyramidal symmetry is striking and its light green feathery foliage gives it pleasing texture. A rapid grower, sheds its leaves in autumn.

Habit and Uses: Upright tree, pyramidal when young, and ultimately growing to 100 feet or more. Promises interest as a specimen tree.

Hardiness: Hardy to at least Zone 5. Native to China.

Culture: Dawn-redwood seems to do well in most any soil, whether reasonably acid or alkaline. In moderately moist situations of fair fer-

(*Continued on page* 238)

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Sour-gum or Pepperidge
Nyssa sylvatica

Outstanding Features: This somewhat scraggly grower has a certain picturesque quality that gives it unusual character as an ornamental tree. Its closely spaced horizontal branching habit resembles that of pin oak, and its dark green lustrous leaves are brilliant in autumn with their scarlet to orange hues. It is one of autumn's most spectacular trees. Its ability to thrive in wet soils adds to its usefulness.

Habit and Use: Somewhat pyramidal tree growing 90 to 100 feet tall. The branches are dense, and horizontal or slightly pendulous. Good specimen or accent tree, especially useful in wet or swampy spots.

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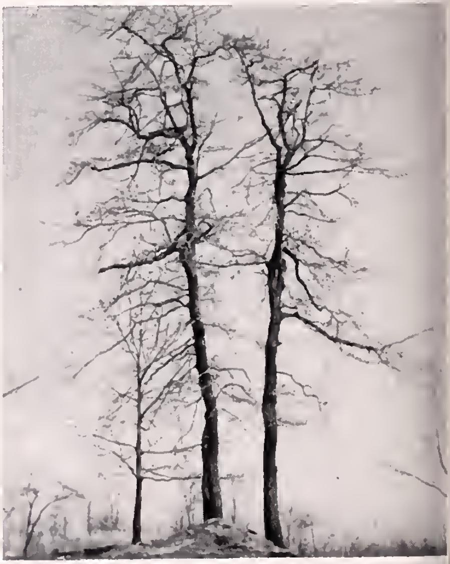

Wodehouse

Among the narrow-leaved evergreens, certain kinds of pines deserve attention. For year 'round fine-textured "green" and the frequent picturesqueness of older specimens, often growing under trying circumstances, they cannot be surpassed. Our Selections Committee has agreed on three kinds of pines for inclusion in this list of outstanding trees for temperate climates. There could be several more, such as the Korean pine (*P. koraiensis*), Japanese white pine (*P. parviflora*) and some of the native pines of the northwest.

McFarland

Eastern white pine

Eastern White Pine ***Pinus strobus***

Outstanding Features: One of North America's magnificent native trees, beautiful throughout the year. The needles of white pine are 2½ to 5½ inches long, flexible and delicate in texture, and a pleasing soft green color at any season.

Habit and Use: Eastern white pine is a tall, rounded or pyramidal tree, reaching 100 to 150 feet when mature. Old specimens often acquire

(*Continued on page* 238)

Swiss Stone Pine ***Pinus cembra***

Outstanding Features: Noted for its compact, narrow pyramidal habit and its dark green needles which are retained for about 3 years.

Habit and Use: Under ideal growing conditions the Swiss stone pine is ultimately a tall, narrowly pyramidal tree which might reach close to 100 feet. In ornamental plantings around a home, its slow growth prevents size from becoming a problem.

(*Continued on page* 238)

McFarland

Sourwood, or Sorrel Tree *Oxydendrum arboreum*

Outstanding Features: Definitely one of the finer ornamental trees. Its lustrous, small, leathery leaves give it a warm texture, and its drooping yet spreading flower clusters (equally attractive in bud, and visible much of the year) combine to give this tree special quality. It is strikingly beautiful in its brilliant scarlet autumn foliage. The lacy fruit clusters continue to be decorative right on into the late autumn and early winter.

Habit and Use: Most attractive as a small tree in its first 2 to 35 years with the lower branches kept on. It has a pyramidal habit, with a rounded top. Sourwood makes a good background tree for a large border and is even better as a specimen tree growing at the edge of a lawn.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Sourwood does best in open situations in moist, somewhat acid soils.

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Himalayan Pine *Pinus griffithi*

Outstanding Features: The leaves of this 5-needled pine are blue-green in color, soft in texture, and 5 to 8 inches long. They droop in such a way as to give a cascade effect to the whole tree.

Habit and Use: Wide-spread, fast-growing tree which may reach 150 feet in height. A magnificent specimen tree wherever ample space is available.

Hardiness: Hardy to Zone 5. Grows satisfactorily as far north as Long Island and the Connecticut shore, and in temperate areas of the northwest. Native to the Himalayas.

Culture: Does best in a light sandy loam, with full sun.

Buhle

Oriental cherry, variety KWANZAN *Roche*

Oriental Cherry
Prunus serrulata

Outstanding Features: The oriental cherries are grown primarily for their beautiful floral display in the spring. Flowers precede the leaves in normal seasons, and provide an unsurpassed display.

Habit and Use: Mostly small, upright trees, to 20 or 25 feet. Use as specimen trees, keeping in mind that they are of great ornamental interest only during the comparatively short blossoming period.

Hardiness: Hardy to Zones 5 or 6, depending upon variety. Native to Japan, China and Korea.

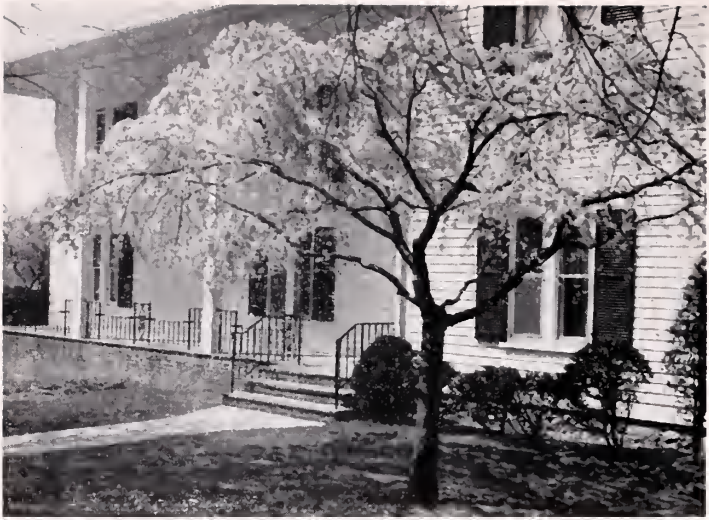
Culture: Flowering cherries will grow in most reasonably good garden soils, if well drained. They should have full sun. They are often planted beside lakes or ponds, where they admittedly look very beautiful, but may fail because of lack of drainage. Cherries are subject to scale insects which can be controlled by spraying with a dormant oil spray.

Varieties: Many varieties of Oriental cherries are available. The following are among the best.

KWANZAN, the most popular and one of the most beautiful. It has the added advantage of being also the hardiest. The flowers are very double, about 2½ inches in diameter, deep pink in color, and borne in greatest profusion.

SHIROTAE is a beautiful white, the blossoms not quite as double as those of KWANZAN.

AMANOGAWA is one of the few fastigiate cherries, having a very narrow, upright habit, similar to that of Lombardy poplar. The flowers are semi-double, light pink and fragrant.



Roche

Japanese Weeping Cherry
Prunus subhirtella pendula

Outstanding Features: The weeping cherry is prized for its graceful pendulous branches and for the myriads of small, single, pink flowers which cover it in spring.

Habit and Use: Small tree which may reach 30 feet but is usually much less, rather wide-spreading with long, slender, pendulous branches giving a "fountain" effect. A specimen tree that should be seen from a little distance to be thoroughly appreciated.

Hardiness: Hardy to Zone 5. Native to Japan.

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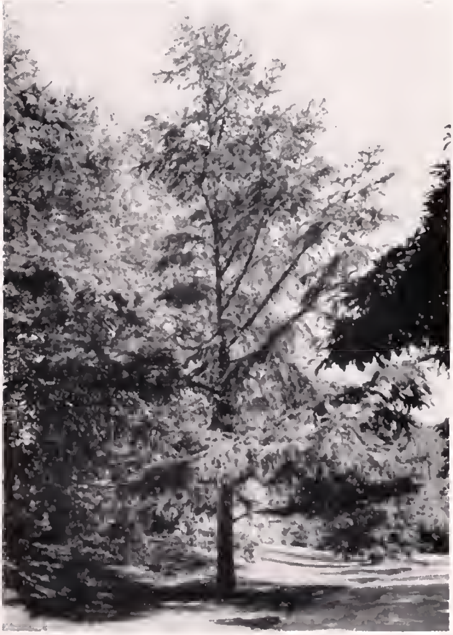

Buhle

Golden-larch
Pseudolarix amabilis

Outstanding Features: The golden-larch has graceful branches bearing short, flat, light green needles in flat rosettes. Their effect on the tree as a whole is light and airy. In autumn they turn a not-very-attractive yellow for a short period before they are shed. The winter twigs have a rare and beautiful symmetry.

Habit and Use: This species loses its needles in winter. It is a broad, irregularly pyramidal tree of rather open growth, ultimately reaching 100 feet or more in height. Fine specimen tree for large gardens.

Hardiness: Hardy to Zone 5. Native to China.

Culture: Golden-larch does best in a moist, sandy loam. It is comparatively free of pests and diseases.

(*Continued on page* 239)

Oaks *Quercus species*

The oaks are outstanding trees, valued as ornamentals for numerous reasons, including their branching majestic proportions when mature, the brilliant autumn foliage color characteristic of certain species, and their ready adaptability to diverse growing conditions. Other species than the selections that follow can well be regarded as outstanding in certain geographic areas.

White Oak *Quercus alba*

Outstanding Features: White oak is noted for its broad crown with far-reaching branches, its sturdy trunk and its bright green leaves which have a much paler lower side. It is a tree of "character," once known never to be forgotten.

Habit and Use: The white oak is a mighty tree which grows to more than 100 feet. Under favorable circumstances, without competition, it might live a thousand years or more. It is usually almost perfectly rounded in outline with thick and sturdy horizontal branches and characteristically lobed leaved. It makes a majestic shade tree when mature. Because of its size, it is not a tree for small gardens.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

(*Continued on page* 239)

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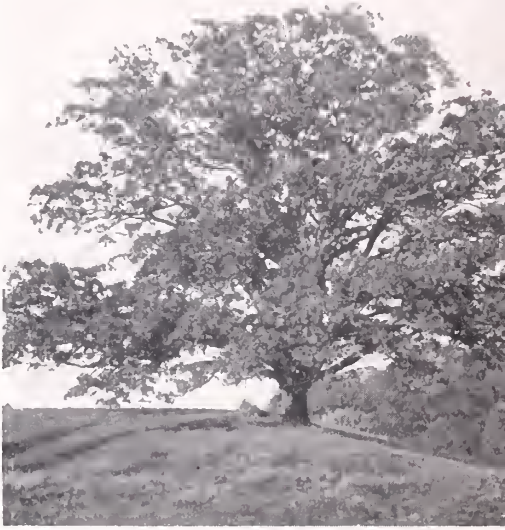
Willow Oak *Quercus phellos*

Outstanding Features: While this tree lacks some of the outstanding characteristics generally associated with oaks, it is finer in texture than any other. The light green, shiny leaves are narrow and pointed, shaped much like those of a willow, and are from 2½ to 5 inches long. It is definitely "different," and a choice tree in its own way.

Habit and Use: Densely branching, round-topped tree growing to 50 feet in height. Used as specimen tree and for street plantings.

Hardiness: Hardy to Zone 5. Native to eastern and southern United States.

Culture: Does well in any good garden soil but seems best in acid soils. Easy to transplant.



White oak *Buhle*

Scarlet Oak *Quercus coccinea*

Outstanding Features: The bright green, glossy foliage of scarlet oak is open, casts a light shade. In autumn it turns to brilliant scarlet.

Habit and Use: Open, round-topped tree, with ascending, slender branches. Grows to 70 feet or more. Lower branches may droop almost to ground. Excellent for street tree or specimen tree of rather large stature.

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Will do well in most soils, tolerates rocky and sandy soils and drought. It is difficult to transplant. For assured success in moving, it should be root-pruned a year before transplanting.

Variety: var. *splendens* has more glossy leaves than the species.

U. S. Forest Service

Redwood ***Sequoia sempervirens***

Outstanding Features: Redwood is noted for its great height and stateliness as a mature tree, and its beautiful dark, evergreen needles which contrast with the deep-furrowed reddish bark.

Habit and Use: Tall, narrow tree reaching a height of 350 feet or more at maturity. If to be allowed to grow to its ultimate stature, should be used only in large gardens as a specimen plant or lawn tree.

Hardiness: Hardy to Zone 7. In the east it grows north to Virginia. Native to west coast of North America.

Culture: Redwood thrives in rich soil with plenty of moisture, and apparently needs moist atmosphere as well (see Plants & Gardens, Vol. 7, p. 113-119, 1951).

Pin Oak ***Quercus palustris***

Outstanding Features: Because of its dense branching, shape and texture, the pin oak is striking in winter as well as when it is in leaf. The leaves are dark, glossy green, turning scarlet in autumn.

Habit and Use: Pin oak grows to a height of 75 to 80 feet. It has a very good, full pyramidal form resulting from the peculiar growth of the branches—the upper ones grow upright, the middle ones horizontally, and the lower branches are slightly pendulous. It is a fine lawn or specimen tree, but somewhat limited for use along streets or highways because the lower branches affect visibility.

Hardiness: Hardy to Zone 4. Native to eastern United States.

Culture: Pin oak grows best in a moist, rich, clay loam. It does poorly in alkaline soils. If the soil is not right, it is apt to show chlorosis, i.e., the leaves lose their green color. This condition can probably be best treated by using iron chelates (see Plants & Gardens, Winter 1954-55, page 258). Transplants well.

U. S. Forest Servic

U. S. Forest Service

Giant Sequoia

Giant Sequoia
Sequoiadendron giganteum

Outstanding Features: Noted for its great size and especially the enormous trunk at maturity. The foliage is almost scale-like, the needles closely overlapping the twigs. Worthy of special note chiefly for its size at maturity, but not as a younger tree.

Habit and Use: Giant sequoia is not so tall at maturity as the redwood, reaching heights of about 300 feet, but it is more massive, with a dense pyramidal crown. The trunk is very thick, with reddish, heavily ridged bark. Unsuited to any but large gardens, where it can develop into a magnificent specimen tree in a few hundred years. In the east there are well established specimens as far north as Rhode Island.

Hardiness: Hardy to Zone 6. Native to western slopes of the Sierra Nevada range in California.

Culture: Giant sequoia is hardier than

(*Continued on page* 239)

Japanese pagoda tree in fruit

Buhle photos

Japanese Pagoda Tree
Sophora japonica

Outstanding Features: Judged by any criteria, this is easily one of the world's finest trees for ornamental use. It blooms in summer (large, loose clusters of small cream colored, sweet-pea-like flowers), and its yellow-green pods in the autumn are handsome in their own right. While it provides no autumn foliage color, its feathery, dark green leaves are attractive from the time of their appearance until they are shed in fall.

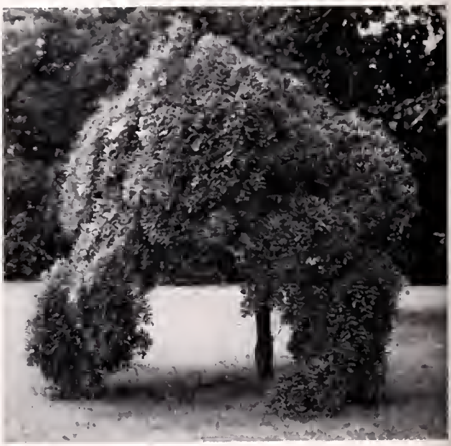
Habit and Use: A rounded tree with wide-spreading branches. It is useful in many situations, as a shade tree, lawn or specimen tree.

Hardiness: Hardy to Zone 4. Native to China and Korea.

Culture: Sophora grows well under almost any conditions, including poor, rocky, dry soils. It withstands city and seacoast conditions and is comparatively free from pests and disease.

Variety: *Sophora japonica* var. *pendula* has weeping branches. It seldom blooms, but is a good specimen tree.

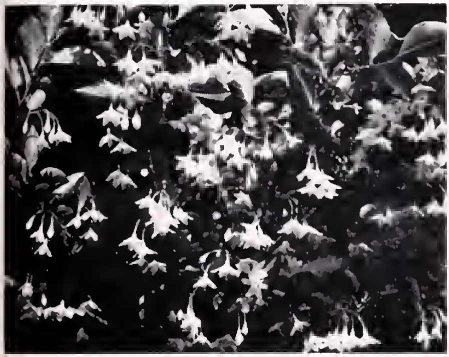
Weeping form of Japanese pagoda tree



Japanese Snowbell

Styrax japonica

Outstanding Features: Snowbell gets its common name from the small, fragrant, white flowers which are borne in clusters along the branches in the early summer. These flowers are effectively displayed even though the tree is in full leaf at flowering time, because they hang down from the undersides of the branches, while the leaves grow more or less upright on the branches.



Habit and Use: Small tree, to 30 feet in height. The graceful branches spread, making the plant often wider than it is high, with a flat top. Good specimen tree, or for the back of a shrub border.

Hardiness: Hardy to Zone 5. Native to China and Japan.

Culture: Snowbells do best in light, well drained soil, in open situations.

Other Kinds: Fragrant snowbell (*Styrax obassia*) is a more or less columnar tree, with large leaves. It is a tree of considerable beauty while in bloom, in early summer.

* * *

Bald-cypress

Taxodium distichum

Outstanding Features: While this tree is best known as an inhabitant of swamp lands in the South, it makes a handsome ornamental specimen in temperate regions. The foliage is soft and feathery, a pleasing light green in color. Like the larches, bald-cypress sheds its needles in winter. The trees are famous for the strange knees that develop on the roots when they grow in swamps, but these are rarely evident in garden plantings.

Habit and Use: Bald-cypress may attain a height of 125 to 150 feet at maturity. When young it is slender and pyramidal, becoming rounded with age. Useful as a specimen tree. Its ability to thrive in wet swampy areas makes it useful in such places

(*Continued on page* 239)

McFarland photos

Canada Hemlock

Tsuga canadensis

Outstanding Features: The fine texture and graceful habit of this evergreen tree make it one of the most-prized ornamentals for temperate regions. Its needles are dense and give a beautiful feathery appearance to the branches. It may be clipped to almost any desired form and height, and this, together with the many available varieties, makes hemlock a most valuable, versatile evergreen.

Habit and Use: Canada hemlock is a pyramidal tree with slender, often drooping branches. It attains a height of 90 feet, but by clipping and pruning can be kept to a height of only a few feet, making a fine hedge in full sun or partial shade. Unclipped, it will grow in full shade. There are more than 50 varieties known, many available in the trade. Hemlocks make superb lawn and specimen trees.

Hardiness: Hardy to Zone 3. Native to eastern North America.

Culture: Grows best in well drained loam, in shade, but will stand full sun and even somewhat "wet feet." Its foliage burns in open situations in winter. Because of the shallow roots tall trees may be blown down by wind.

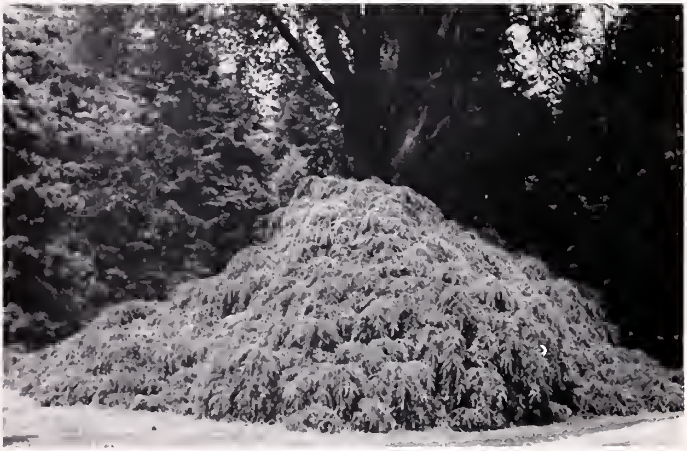
Other Kinds:

Sargent's weeping hemlock (var. *pendula*) is an attractive low-growing hemlock. It forms a spreading mound, wider than it is high, with drooping branches.

Carolina hemlock (*Tsuga caroliniana*) is similar to Canada hemlock and can be used in the same ways. It is not quite so hardy (to Zone 4) but is somewhat more tolerant of city conditions.

McFarland

Buhle



Sargent's weeping hemlock

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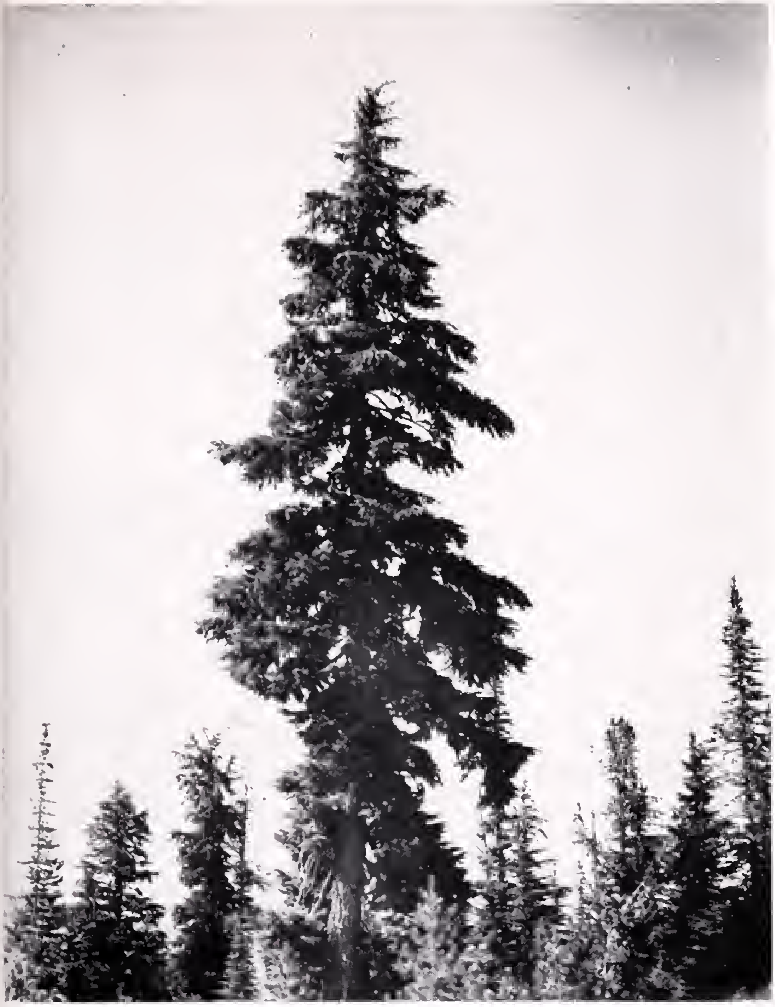


U. S. Forest Service

Magnificent specimen of Mountain hemlock

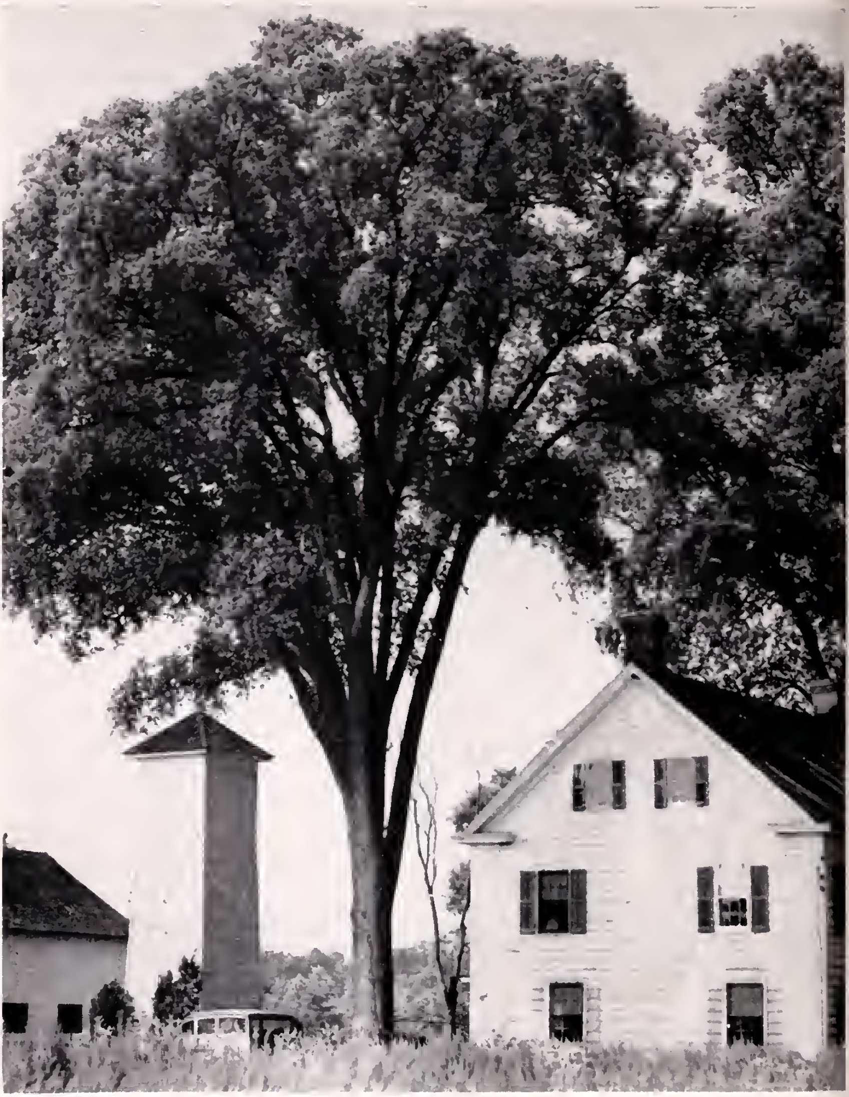
Mountain Hemlock
Tsuga mertensiana

Outstanding Features: The irregularly pyramidal growth of this species, plus its glossy, blue-green needles arranged in star-like clusters something like those of the golden larch, give it a picturesque quality. It deserves to be better known in cultivation.

Habit and Use: Pyramidal tree reaching 60 to 80 feet in height. Used in the same ways as Canada hemlock.

Hardiness: Hardy to Zone 1. Native to western North America.

Culture: Similar to that for Canada hemlock.



Roche

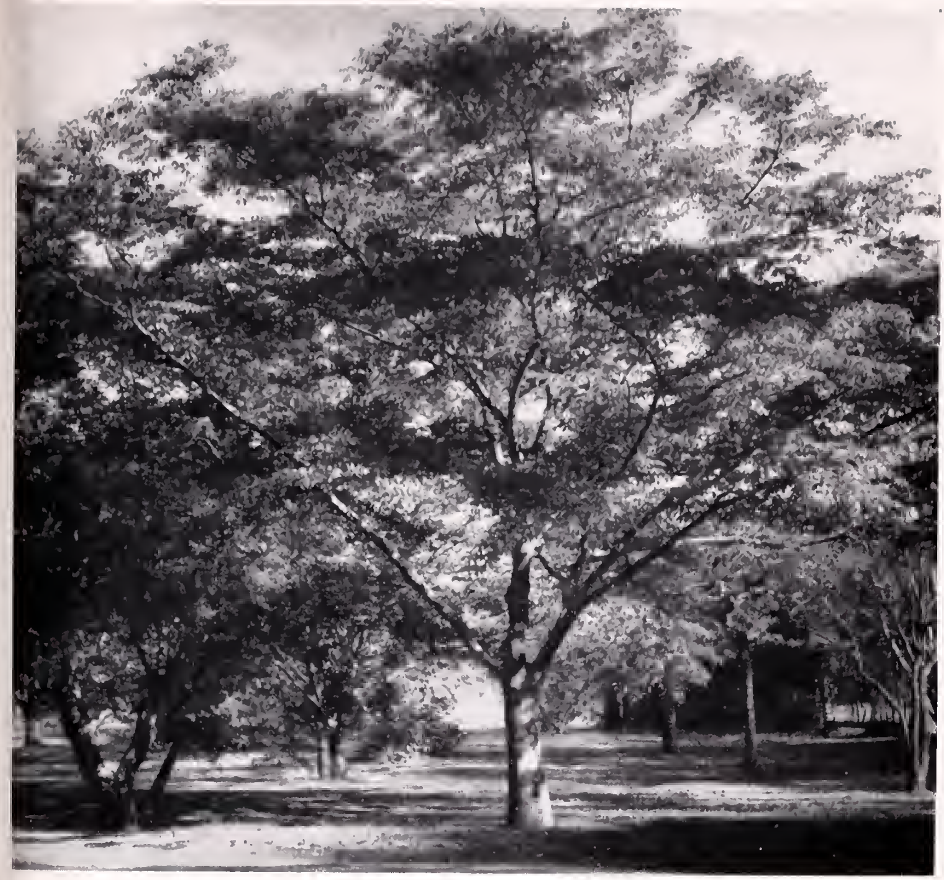
Typical American elm

American Elm ***Ulmus americana***

Outstanding Features: One of the finest specimen trees and street trees, the American elm must be included in any list of the one hundred best. It cannot be recommended for general planting at the present time, unfortunately, because of the two killer diseases which promise to destroy it: Dutch elm disease and phloem necrosis disease. For persons who like the graceful vase shape habit of elm, Japanese zelkova (*Zelkova serrata*) can be recommended. It is described below.

Habit and Use: Tree growing to 100 or 120 feet at maturity, with a very characteristic, graceful vase shape.

Hardiness: Hardy to Zone 2. Native to North America.



Buhle

Young Japanese zelkova tree

Japanese Zelkova
Zelkova serrata

Outstanding Features: Graceful em-like habit and rapid growth are valuable traits of zelkova. The foliage is dense, much like that of elm, and turns russet to reddish in autumn.

Habit and Use: A fast-growing tree reaching a height of 50 to 90 feet. It has a rounded top, with wide-spreading branches, and is nearer in form to the American elm than almost any other tree. Because of its similarity to American elm, and its mechanical resistance to Dutch elm disease that threatens elm with extinction, it is useful as a substitute for that tree in street and lawn plantings.

Hardiness: Hardy to Zone 5. Native to Japan.

Culture: Zelkova grows well in a variety of soils, will tolerate alkaline soil and drought. Withstands sun and wind.

Rembrandts among the

SHRUBS

Shrubs set the stage of every well designed ornamental planting. If a shrub is beautiful and is given the care called "proper pruning," it goes on being beautiful —i.e., once well established it does not greatly change. Shrubs may lack the majesty inherent in trees, but their contribution to the beauty and form of the garden is no less significant.

Rembrandt van Rijn from a self-portrait.

Flowers of abelia

Abelia ***Abelia grandiflora***

Outstanding Features: The glossy leaves of abelia are small, pointed, dark green, and remain on the bush far into the winter. Its attractive small flowers are fragrant, white with a tinge of pink, and are produced from June until autumn. A pink flowered variety is also attractive.

Habit and Use: Rounded in form and growing about 4 feet, this is a good

(*Continued on page* 239)

Bearberry

Arctostaphylos uva-ursi

Outstanding Features: Small, glossy, evergreen leaves and low habit make this a most desirable little plant. In spring it has small pink flowers, followed in fall by small red berries.

Habit and Use: Bearberry is a creeping plant, making dense mats up to 8 inches high. It is excellent as a ground cover, especially in sandy

(*Continued on page* 239)

Buhle photos

Bearberry

Rosemary barberry

University of British Columbia

Rosemary Barberry
Berberis stenophylla

Outstanding Features: This fine-textured shrub with somewhat rounded growth habit, has slender spine-bearing branches and glossy dark green very narrow leaves. These are evergreen south of Washington, D. C., but semi-evergreen or deciduous farther north. The attractive flowers are bright yellow, the fruits black covered by a waxy bloom.

Habit and Use: The rosemary barberry is a rounded, somewhat spreading shrub sometimes reaching a height of 8 or 9 feet, but usually much lower. Because of its spiny branches, this plant can be well used as a barrier hedge, in foundation plantings, in the border, or as an individual specimen plant.

Hardiness: Hardy to Zone 5. Hybrid, parents native to Chile.

Culture: Does well in a variety of soils, especially light sandy or loamy ones. It is resistant to diseases and pests and immune to black stem rust of wheat.

* * *

Japanese Barberry
Berberis thunbergi

Outstanding Features: Its vigorous, thorny growth and reasonably delicate foliage make this a favorite hedge plant, though too frequently used. Flowers are not significant. If planted in the open, the fall coloring of the foliage can be very brilliant; the red berries last well into winter.

Caution: birds scatter the seeds, so guard against its becoming a weed shrub in wild or semi-wild areas near hedge plantings.

Habit and Use: Dense shrub growing to 6 feet, but lending itself well to pruning for low hedge.

Hardiness: Hardy to Zone 4.

Culture: Will grow in difficult places where light and soil are poor, so it is often planted in such situations. Under such conditions it naturally cannot grow to perfection and does not make a good showing. Well grown and cared for, given moderately good, well drained soil and plenty of light, it is a very satisfactory plant. Other species of *Berberis* deserve attention as outstanding plants, particularly in mildly temperate regions. Among these are *B. verruculosa*, *B. chenaulti*, and *B. triacanthophora*.

McFarland

Boxwood hedge allowed to develop natural "billowy" form

Common Boxwood
Buxus sempervirens

Outstanding Features: Boxwood is prized for its small, dark, evergreen leaves and its dense, "billowy" habit of growth.

Habit and Use: Slow-growing shrub or small tree ultimately reaching to 25 feet. Old plants can be splendid as individual or clumped specimens; younger ones are much used for borders and hedges.

Hardiness: Hardy to Zone 5. Native to Europe, North Africa and West Asia.

Culture: Boxwood will grow in most reasonably good soils if they are well drained. If the shallow roots are buried too deeply they will smother. On the other hand, care must be taken that they are not actually exposed by washing away of soil. In more severe climates, boxwood must be protected in winter from direct sun to avoid foliage burn. The boxwood leaf miner is the most serious pest; control with D.D.T. or malathion.

Variety: There are many varieties of common boxwood, a number of which are outstanding. One of these is TRUE DWARF (var. *suffruticosa*). It is smaller than the ordinary common boxwood, very slow-growing, with leaves up to ¾ inch long.

Clipped boxwood hedges

Roche

Common camellia bush

Common Camellia

Camellia japonica

Outstanding Features: The beautiful blossoms, in many shades of red and pink to white, some striped or mottled, well set-off against the shining, dark, evergreen foliage, make camellia one of the most desirable of flowering shrubs for mild climates.

Habit and Use: Common camellia is a shrub or small tree which may ultimately reach 20 feet. It is among the finest of specimen plants where it can be grown to perfection; it can also be espaliered against a wall or fence.

Hardiness: Camellias are commonly rated as hardy only to Zone 7, but certain varieties have been grown successfully on Long Island and as far north as Yonkers, New York (see Plants & Gardens, Autumn 1956, page 264). Native to China and Japan.

Culture: Camellias do best in a soil that is somewhat acid, not too heavy, well drained, and in partial shade.

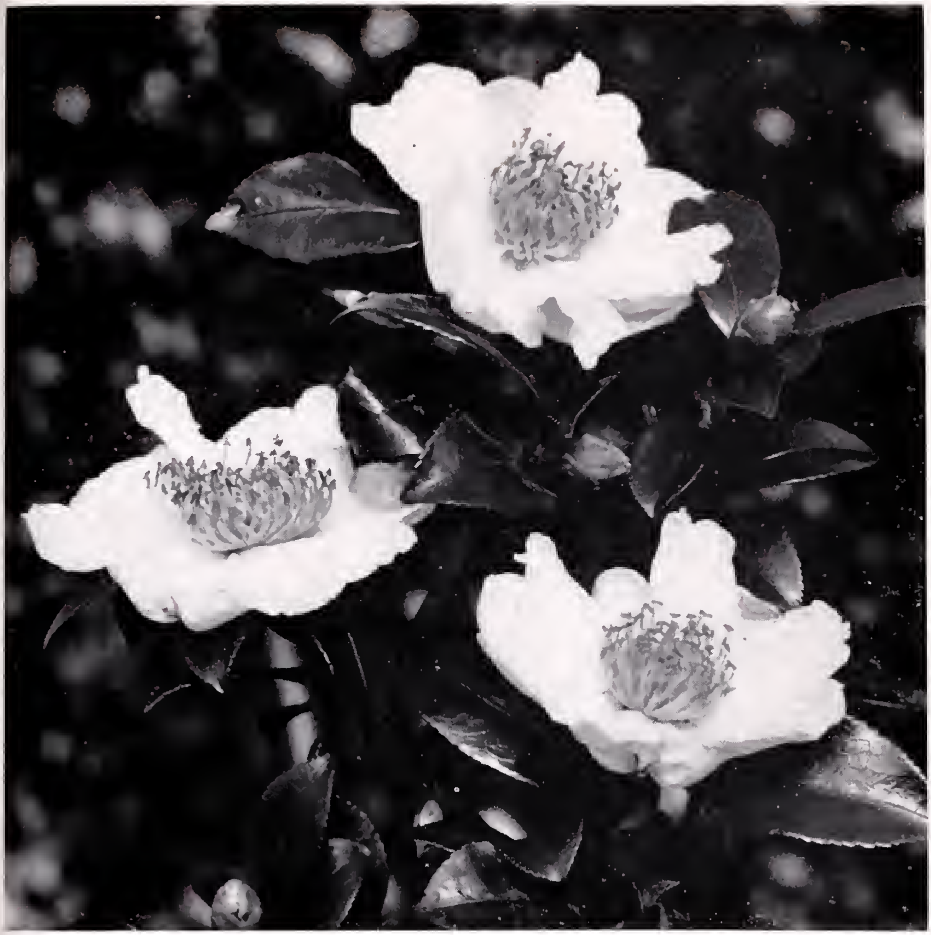
They are fairly free from pests but camellia flower blight may be troublesome (see Plants & Gardens, Spring, 1955, page 72).

Varieties: There are a great many splendid varieties of common camellia. The following are representative:

Lady Clare—carmine rose
Auburn White — white with faint tinge of pink
Coquetti—turkey red
Elegans—carmine, variable
Nagasaki — carmine, variegated white
Monte Carlo — pink

Common camellia variety Elegans

Roche photos



McFarland

Single-flowered sasanqua camellia

Sasanqua Camellia

Camellia sasanqua

Outstanding Features: The flowers of sasanqua camellias are on the whole more delicate than those of common camellias. Many of them are single, but they exhibit the same range of attractive colors.

Habit and Use: Similar to that of common camellia.

Hardiness: Hardy to Zone 7, and like common camellia, probably under proper conditions farther north. Considered more hardy than common camellia, but this is open to question. Native to China and Japan.

Culture: Same as for common camellia.

Roche

Blossoms of flowering quince

Flowering Quince
Chaenomeles japonica and *C. lagenaria*

Outstanding Features: Flowering quinces are planted chiefly for their brilliant pink, red or white flowers which are borne abundantly early in the spring, preceding the leaves. Some varieties give scattering bloom from time to time through the summer and fall.

Habit and Use: Rather sprawling, much-branched shrubs, *Chaenomeles japonica* growing to about 3 feet high, *C. lagenaria* to 6 feet. They are useful in the shrub border or as specimen plants, and are available under many variety names.

Hardiness: Hardy to Zone 4 and in protected places in Zone 3. Native to China and Japan.

Culture: Flowering quinces do well in any good garden soil, in open situations or very light shade. They can be easily transplanted.

Sweet Pepper-bush ***Clethra alnifolia***

Outstanding Features: Sweet pepper-bush produces clustered spikes of attractive white, spicily fragrant flowers from midsummer on into late summer, when few other shrubs are in bloom.

Habit and Use: Bush of somewhat upright habit, growing to 9 feet. Useful in partially shaded borders and in naturalized plantings. Does well along the seacoast.

Hardiness: Hardy to Zone 3. Native to Eastern United States.

Culture: Does best in moist soils and partial shade, but adapts well to dryer and more open situations.

Variety: var. *rosea* has soft pink flowers.

McFarland

Sweet pepper-bush

Winter-hazel ***Corylopsis* species**

Outstanding Features: Small, lightly fragrant, yellow flowers in attractive drooping clusters borne before the leaves appear in early spring are the valuable contribution of these charming shrubs.

Habit and Use: Wide-spreading, growing to about 6 feet in height. Useful in the shrub border or in woodland plantings.

Hardiness: Hardy to Zone 5. Native to China and Japan.

Culture: Winter-hazels do best in a moist, well drained soil that is rich in peat.

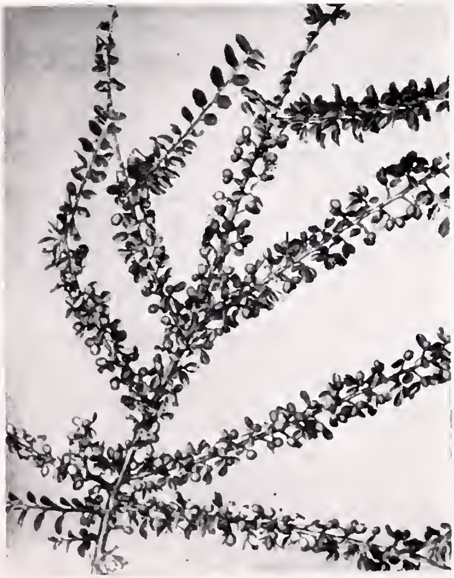
Kinds: While *Corylopsis sinensis* is perhaps the most attractive and best known, there are several other worthy species, among which are *C. pauciflora, C. spicata* and *C. glabrescens.*

Winter-hazel

Buhle

Rock cotoneaster *McFarland*

Spray of rock cotoneaster with fruit *Roche*



Rock Cotoneaster *Cotoneaster horizontalis*

Outstanding Features: The branches of rock cotoneaster have a striking flat, fishbone pattern which makes a delicate tracery. They bear very small, glossy, green leaves and in fall, bright red berries. Excels for foliage and unique growth pattern.

Habit and Use: Low, spreading shrub, reaching 3 feet in height. Best used in rock gardens or as a specimen plant on lawns where it can be permitted to grow to full size. Sprawls gracefully over rocks, and may be espaliered on walls.

Hardiness: Hardy to Zone 5. Native to China.

Culture: Does best in sunny, open situations, in light, well-drained soil. Easily transplanted when young, less so when older.

McFarland

Early cotoneaster has large, showy fruit

Early Cotoneaster
Cotoneaster adpressa praecox

Outstanding Features: In addition to its low, rounded habit this cotoneaster has small, shining, rich green leaves and in autumn an abundance of showy large bright red berries. A charming shrub among the low growers.

Habit and Use: Low-growing mounded shrub, 1 to 1½ feet high. Useful as a single accent shrub, especially in formal plantings.

Hardiness: Hardy to Zone 5. Native to China.

Culture: Like most cotoneasters, this variety does best in sunny situations, in a light and well drained soil.

Other Cotoneasters: There are many other species of *Cotoneaster* that are outstanding ornamentals. Particularly good are *Cotoneaster divaricata*, which grows to 6 feet with dark green, shiny leaves, pink flowers and bright red fruit. Its foliage develops a rather handsome dark purple hue in autumn. Excellent as a specimen plant. Makes a good border shrub. *C. salicifolia* is a very handsome large shrub with elongated wrinkled leaves, quite unlike the other cotoneasters. Good as a tall border shrub, a specimen plant, or may be sheared as an unusual hedge plant.

Roche

Garland Flower *Daphne cneorum*

Outstanding Features: In spring this attractive spreading little shrub is covered with clusters of small, very fragrant, pink to red flowers.

Habit and Use: Low-growing, seldom exceeding 6 inches in height. Excellent for rock garden or borders.

Hardiness: *Daphne cneorum* is hardy to Zone 4, and can be grown much farther north if protected by snow cover in winter. Native to European mountains, where at higher elevations it is extremely dwarf.

Culture: Will grow in either acid or alkaline soils which are well drained, but is "choosy" about growing in some situations which seem to provide ideal conditions.

* * *

Redvein Enkianthus *Enkianthus campanulatus*

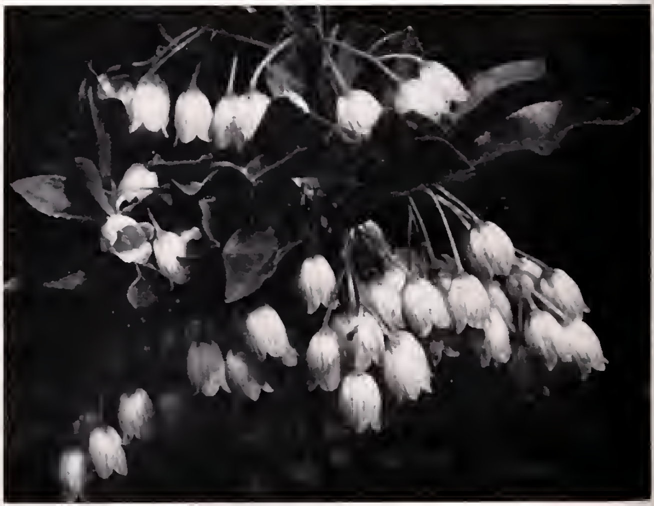
Outstanding Features: In spring, about the time the leaves develop, enkianthus bears unique clusters of drooping, bell-shaped little flowers of dull yellow or orange veined with dark red. They are not showy, but have considerable charm. In autumn the foliage takes on brilliant orange or scarlet color.

Habit and Use: A somewhat erect, narrow shrub growing under ideal conditions to a height of 15 to 30 feet. Useful as a specimen plant, and for combining with azaleas and rhododendrons, or for the edges of ponds and streams.

Hardiness: Hardy to Zone 4. Native to Japan.

Culture: Enkianthus thrives in moist acid soil, under much the same conditions as those best for azaleas and rhododendrons. When grown in drier soils, it can be held to a height of about 6 feet.

McFarland



Attractive bell-shaped flowers of enkianthus

Glossy Wintercreeper
Euonymus fortunei carrierei

Outstanding Features: Very glossy, dark evergreen leaves about 2 inches long, sometimes margined with white, make this a valuable shrub. Flowers are insignificant, but they are followed by attractive berries, red with pink capsules. This is one of the most fruitful of the entire euonymus group.

Habit and Use: This variety of wintercreeper is shrubby, slow-growing, eventually reaching 3 to 4 feet. It can be used as a specimen plant and in foundation plantings.

Hardiness: Hardy to Zone 5, and if protected, a little farther north. Native to Japan and Korea.

Culture: Will do well in any good garden soil, and will grow in shade. Slight tendency to become vine-like can be controlled by pruning. Scale may be a problem and requires vigilance to keep under control (see Plants & Gardens, Spring 1955, page 19).

Spreading euonymus in bloom

McFarland photos

Glossy wintercreeper berries

Spreading Euonymus
Euonymus kiautschovica (E. patens)

Outstanding Features: Glossy, dark green, leathery leaves remain on plant in good condition throughout the winter. Plant is covered with loose clusters of small greenish flowers in late summer or early fall. These are followed by pink-capsuled fruits. In northern parts of its range, fruits may not have time to mature.

Habit and Use: Semi-evergreen shrub growing to about 7 feet high, forming broad clumps. Useful as specimen plant and in combination with broad-leaved evergreens. Can be clipped for hedge.

Hardiness: Hardy to Zone 6. Native to China.

Culture: Will grow well in any reasonably good garden soil. In open places leaves may become scorched in winter and remain unsightly into spring, so is best planted when it has winter shade.

Roche

Forsythia ***Forsythia* species**

Outstanding Features: Forsythias are chiefly prized for their masses of cheerful yellow flowers, produced before the leaves in the spring, and among the first flowers to appear. Only one, *F. viridissima* has any value for autumn color; its leaves turn a dark purple late in the season.

Habit and Use: Shrubs of spreading, upright or arching habit, many species growing 7 to 9 feet tall. Among the low-growing types is ARNOLD DWARF, sparse with its flowers until old, but good as a ground cover. Because of their size and spread, most species are not well adapted to the shrub border, but are better as specimen or accent plants.

Hardiness: Hardy to Zone 4, except *Forsythia viridissima* which is the most tender of the forsythias. In the northern parts of the range, the flower buds often die during severe winters. *F. ovata* is least likely to suffer in this way, so is recommended for colder climates, although not outstanding. Native to Europe and Asia.

Culture: Forsythias are not particular when it comes to soil or situation, but for best results should be given full sun and plenty of room. Pruning is of great importance, and poor pruning accounts for many misshapen, poorly blooming plants. Pruning should be done just after flowering, and should consist of cutting back to stubs some of the oldest branches. Heading back an entire bush simply reduces the number of flowers produced. Forsythia is comparatively pest- and disease-free.

Species and Varieties: One of the best is the hybrid variety *F. intermedia spectabilis,* which produces a mass of large, deep yellow flowers. The variety *primulina,* on the other hand, produces pale yellow flowers, preferred by some people. A bud sport of this sold under the name SPRING GLORY has even larger flowers. BEATRIX FARRAND is also outstanding.

A low-growing fothergilla *McFarland*

Fothergilla ***Fothergilla* species**

Outstanding Features: In spring the handsome fothergillas produce thimble-shaped clusters of small white flowers, not spectacular, but attractive. The leaves are rather large, of good texture, somewhat resembling those of witch-hazel. When planted in full sun, the foliage turns beautiful shades of red and orange in the fall.

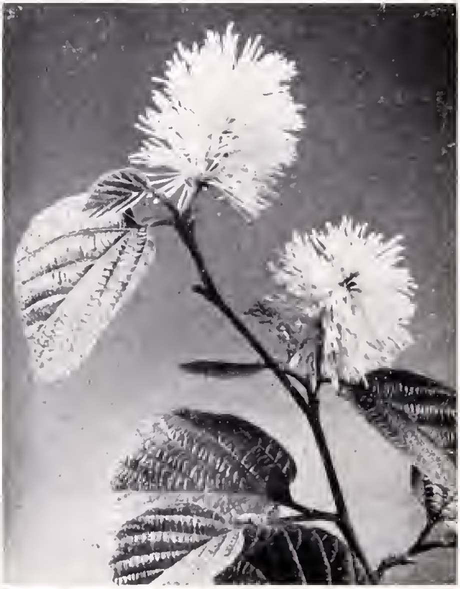
Habit and Use: Sturdy shrubs, generally rounded in habit, growing to 8 or 10 feet (some species are smaller at maturity). Attractive for shrub borders or foundation plantings.

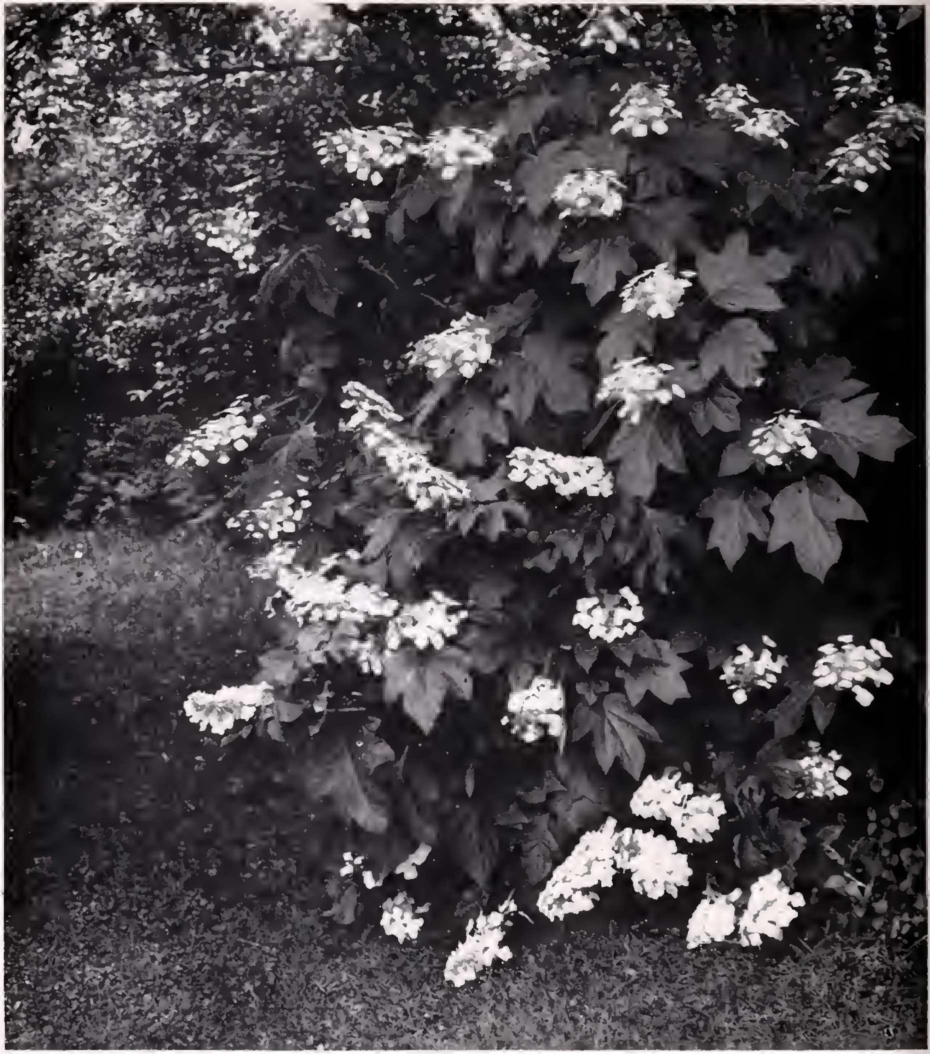
Hardiness: Hardy to Zone 5. Native to North America.

Culture: Any good garden soil is satisfactory. To bring out the fall coloration to perfection fothergillas should be planted in full sun, but they tolerate moderate shade.

Kinds: There are several different kinds of fothergilla, some relatively dwarf, others ultimately growing to about 10 feet. The flowers of some come before the leaves, of others at the same time as the leaves. *F. gardeni* is small and compact, *F. major* is large.

Blossoms of *Fothergilla major*
Roche





McFarland

Oak-leaved Hydrangea
Hydrangea quercifolia

Outstanding Features: The leaves of oak-leaved hydrangea, as the name suggests, are lobed something like oak leaves. They are gray-green on top, whitish and woolly underneath, and produce a rather striking, bold effect. In autumn they take on purplish hues. The white flower clusters are produced in summer and last well into the fall, turning purplish when the leaves do.

Habit and Use. Oak-leaved hydrangea is a wide, roughly rounded bush growing to a height of 3 or 4 feet. It is best used as a specimen plant, especially under trees as it tolerates shade well.

Hardiness: Hardy to Zone 5. Native to eastern North America.

Culture: Will grow well in any reasonably good soil, well drained but on the moist side. Does not tolerate drought well.

St. Johnswort variety HIDCOTE

St. Johnswort *Hypericum species*

Outstanding Features: These shrubs are valued chiefly for their sunny yellow flowers, produced in midsummer and later. These are cup-shaped and from 1 to 3 inches across depending upon the species and variety.

Habit and Use: The ones mentioned are low, rounded shrubs 2 to 3 feet in height. They can be used in shrub borders and in naturalistic plantings. At least one species, *H. buckleyi*, can be used as a ground cover.

Hardiness: Hardy to Zone 5.

Culture: Most St. Johnsworts thrive in light sandy soils, in open situations. *H. kalmianum* will tolerate some shade and moisture soil.

Kinds: There are many species and varieties of St. Johnswort grown in cultivation. Among the best are *Hypericum kalmianum* and the varieties *H. patulum henryi*, HIDCOTE and SUNGOLD. *H. Kalmianum* is native to eastern North America, *H. patulum* to Japan.

Blossoms of a large-flowered St. Johnswort

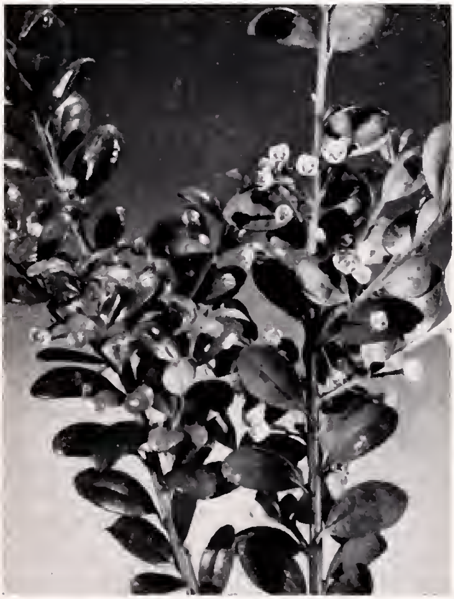
McFarland photos

Buhle

Hedge of *Ilex crenata convexa*

Leaves and flowers of *Ilex crenata convexa*

Roche



Japanese Holly ***Ilex crenata***

Outstanding Features: The evergreen leaves of Japanese holly are small, ½ to 1½ inches long, dark green and shining. The berries are small and black and not especially conspicuous. Valued as a relatively fine-textured broad-leaved evergreen.

Habit and Use: Shrub growing to 20 feet. Excellent for trimmed or untrimmed hedges, foundation plantings. Some varieties are much lower-growing and more spreading than the species (see list below).

Hardiness: Hardy to Zone 6. Worth trying in sheltered areas farther north. Specimens have survived when protected by snow cover in Minneapolis, Minnesota. Native to Japan.

Culture: Japanese holly has about the same cultural requirements as other hollies.

(Continued on next page)

McFarland

Japanese holly, variety *helleri*

Varieties: *Ilex crenata convexa* grows in a rounded mound, twice as wide as it is high. A well-grown specimen is one of the most attractive of shrubs, and is an excellent substitute for boxwood—though looser in its growth.

I. crenata helleri is a compact dwarf, growing only about 1 to 1½ feet high.

I. crenata microphylla is the hardiest variety, has leaves less than ½ in long.

* * *

Burford Chinese Holly
Ilex cornuta burfordi

Outstanding Features: The handsome evergreen foliage of Burford Chinese holly is dark and very glossy. Unlike ordinary Chinese holly, it has few or no spines. The bright red berries last throughout the winter.

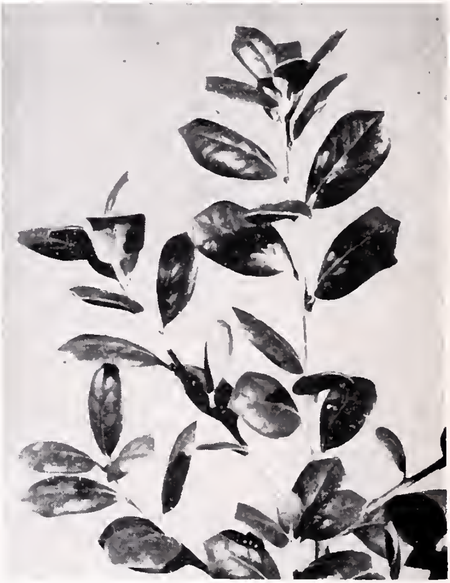
Habit and Use: Rounded shrub growing 9 or 10 feet in height. Can be used as specimen shrub, for hedges, or for foundation plantings.

Hardiness: Hardy to Zone 6 and in some parts of Zone 5. Particularly useful because of its ability to withstand summer temperatures of 100° F. or more.

Culture: Will grow in any reasonably good garden soil, especially if light and well drained. Should be protected from winter sun and wind.

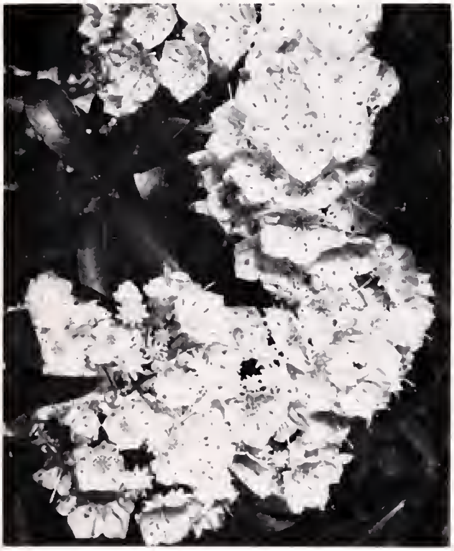
Leaves of Burford Chinese holly

Roche



Mountain-laurel in a natural setting. Picture below shows details of the beautiful flowers

Roche photos



Mountain-laurel ***Kalmia latifolia***

Outstanding Features: Justly prized for its abundance of beautiful pink to white flowers in dense clusters in late spring or early summer, mountain laurel is a favorite native and one of the finest of flowering shrubs. The evergreen leaves are glossy, up to 5 inches long.

Habit and Use: Shrub growing to 10 feet or more. It is best in naturalized plantings, but can also be useful in foundation plantings, on banks, roadsides, etc.

Hardiness: Hardy to Zone 4, with shade and good snow cover it has been grown in Minnesota. Native to eastern North America.

Culture: Must have acid soil, preferably

(*Continued on page* 239)

McFarland

Beauty-bush *Kolkwitzia amabilis*

Outstanding Features: This top-ranking shrub is covered in late spring or early summer with small bell-shaped flowers of a soft pink color, with yellow throats. The gray-green foliage is attractive in itself, blends well with other plants and lasts well into autumn.

Habit and Use: Shrub eventually reaching 8 to 10 feet. Excellent in shrub border, especially in the background (when full grown).

Hardiness: Hardy to Zone 5. Native to China.

Culture: Any reasonably good, well drained garden soil is suitable. Does best in full sun or in very light shade. Should be planted where it has plenty of room for best results; needs periodic drastic pruning.

* * *

Honeysuckle *Lonicera species*

Among the honeysuckles are many beautiful and useful shrubs, most of them providing attractive, though not particularly showy, flowers and fruit. The flowers range in color from white and pale yellow to deep pink. The fruits of most are red, but of some are yellow, or blue. A few of the more outstanding species are listed below.

Blue-leaf Honeysuckle *L. korolkowi*

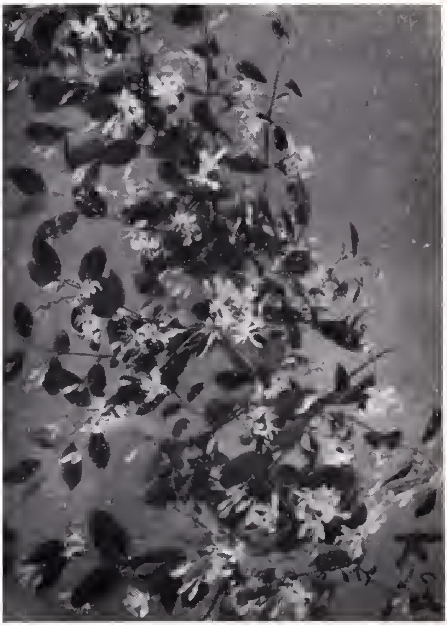
Broadly oval shrub growing to 12 feet. The bluish-green foliage contrasts pleasingly with that of other shrubs.

Belle Honeysuckle *L. bella*

A very floriferous hybrid honeysuckle with pink or white flowers and red fruit.

Box Honeysuckle *L.nitida*

A dainty shrub with minute evergreen leaves. Grows only to about 6 feet. Hardy only to Zone 6.



Buhle

Blue-leaf honeysuckle

McFarland photos

Pendent flower clusters of Japanese pieris

Japanese Pieris ***Pieris japonica***

Outstanding Features: By any measure, a handsome broad-leaved evergreen. The leaves are lustrous, dark green, up to 3½ inches long. In spring the young leaves are often an attractive bronze color. The blossoms are small, bell-shaped, creamy-white in color, and are borne in drooping clusters up to 5 inches long in early spring. Their pleasant fragrance can be detected only at close range.

Habit and Use: Pieris is an evergreen shrub sometimes reaching 10 feet in height, but generally kept to 3 or 4 feet by selective pruning. It is excellent for shrub borders, etc.

Hardiness: Hardy to Zone 5. Native to Japan.

Culture: Does well in acid soil and partial shade. It will grow in fairly heavy shade, but blooms better with nearly full sun. Tolerates city conditions very well.

McFarland

Firethorn espaliered on stone wall

Laland's Firethorn
Pyracantha coccinea lalandi

Outstanding Features: The chief value of firethorn lies in its small fruit, produced in great quantity and very showy in fall and winter. In this variety they are orange in color. The white flowers, in flat clusters in early summer and the nearly evergreen foliage are also quite decorative, as are the spiny, twiggy branches.

Habit and Use: Laland's firethorn is a small tree or shrub growing to about 20 feet. In warmer parts of its range it can be grown as a specimen plant, elsewhere it lends itself especially to espaliering. Can be trimmed as a hedge, though the pruning involved will somewhat reduce the amount of fruit produced.

Hardiness: Hardy to parts of Zone 4, and worth trying in very sheltered spots, for example against warm walls, into Zone 3. Native to southern Europe and western Asia.

Culture: Firethorns do well in any good neutral or slightly alkaline soil. Fireblight is a serious disease and can best be combatted by cutting off infected branches about 6 inches below the infection. Lacebug and scale may also be problems.

Other kinds: The species, *Pyracantha coccinea,* has scarlet rather than orange berries, hence its common name of scarlet firethorn; it is somewhat less hardy than Laland's (generally Zone 6 southward).

Flowers of firethorn

Roche

McFarland

Rhododendron carolinianum

Rhododendron and Azalea

Rhododendron species, varieties, and hybrids

The number of outstanding rhododendrons and azaleas grown in cultivation runs into hundreds. Any attempt to select just a few of these as the most outstanding would be futile, but without question they must be included as a group in any list of the world's great ornamental plants. For detailed listing and discussion of the various kinds, readers are referred to the publications of the American Rhododendron Society, numerous worthy books, and to Plants & Gardens, Spring, 1949.

Roche

Hybrid tea roses

Rose

Rosa species, varieties and hybrids

The statements made concerning rhododendrons apply with even greater emphasis to roses. Loved and cultivated for centuries, the rose stands near the top of the list of flowering plants in the minds of multitudes of gardeners.

Among the species roses the following are particularly valuable: Father Hugo's rose (*Rosa hugonis*), Austrian briar rose (*R. foetida*), prairie rose (*R. setigera*), and rugosa rose (*R. rugosa*). The rugosa rose does especially well at the seashore. Fine hybrids and varieties are too numerous to mention here. Readers are referred to the many excellent books on roses. Beginners will find PLANTS & GARDENS, Summer, 1955 very helpful.

Canby pachistima

Canby Pachistima
Pachistima canbyi

Outstanding Features: Its low, compact habit and small dark green leaves make this plant a valuable and charming little shrub. In fall the leaves turn a rich bronze.

Habit and Use: A low-growing spreading shrub, reaching to about 1 foot. It makes an excellent fine-textured evergreen ground cover and is good for low hedges, borders, and in foundation plantings.

Hardiness: Hardy to Zone 4 and in parts of Zone 3. It has been grown in parts of Minnesota and North Dakota. Native to the states of Virginia and West Virginia.

Culture: Canby pachistima thrives in well drained, acid soil and either full sun or partial shade.

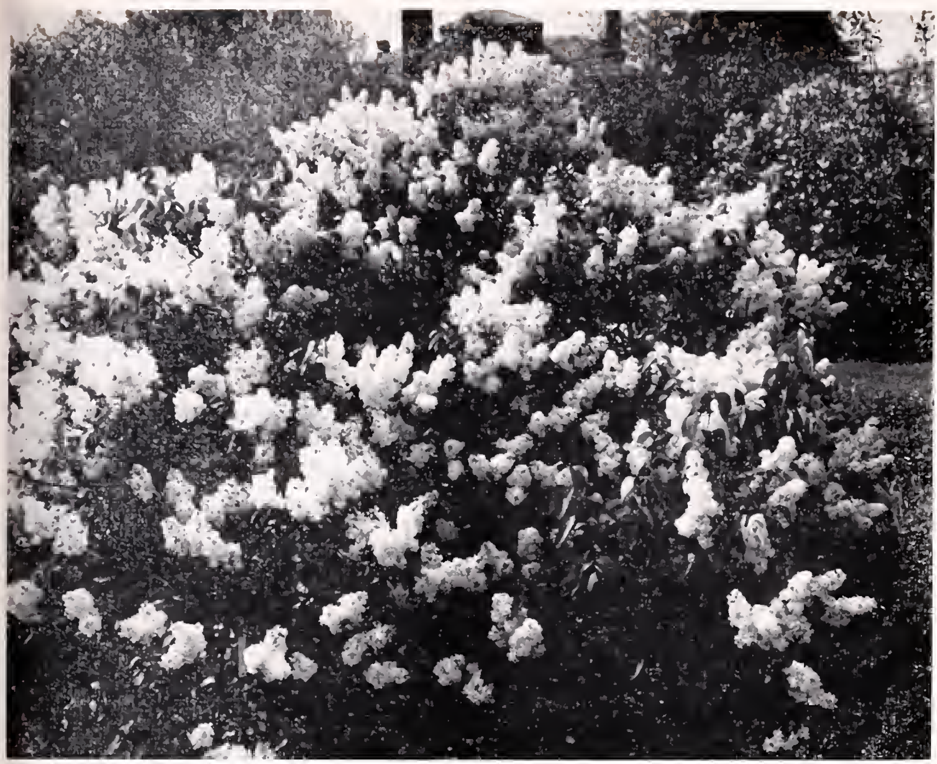
Reeves Skimmia
Skimmia reevesiana

Outstanding Features: In addition to evergreen foliage, this shrub produces clusters of small white flowers in spring, followed by dull red fruits.

Habit and Use: Reeves skimmia is an evergreen shrub growing to 2 feet. Can be used in the foreground of rhododendron and azalea plantings, or in foundation plantings in shaded spots.

Hardiness: Hardy to Zone 6. Native to China.

Culture: Skimmias grow well in a slightly acid soil. They do well in shade but do not thrive in bright sun.



McFarland photos

Hybrid lilac

Lilac

***Syringa* species, varieties and hybrids**

Outstanding Features: Lilacs are grown almost exclusively for their beautiful fragrant flowers, produced in spring.

Habit and Use: Shrubs ranging in height from a few feet in some species to 20 or more in others. They are most useful as background shrubs or specimen plants, some can be used in the shrub border.

Hardiness: Common lilac (*Syringa vulgaris*) and its hybrids are hardy to Zone 3 and even farther north; others, such as the Persian lilac (*S. persica*), only to Zone 5. Native to Europe and Asia.

Culture: The hybrids of the common lilac, which are the most universally prized of the group, will grow in almost any soil. Lilacs should be pruned judiciously every year immediately after flowering. Dead, diseased and weakened wood should be removed to the ground. All suckers should be removed except a few of the more vigorous ones which are left to eventually replace old wood. In the case of hybrids which have been grafted and are not on their own roots, however, suckers are likely to arise from the rootstock and not to be of the desired variety. In pruning these all suckers should be removed and new branches arising near the base of the main stems encouraged to provide replacement wood.

Stewartia *Stewartia* species

Outstanding Features: These shrubs are valued chiefly for their blossoms, which in the two species mentioned below are 3 or more inches across, white with yellow centers, somewhat resembling single white camellias. They are produced in mid-summer when very few other woody plants are in bloom. The dense, dark green foliage turns orange or scarlet in autumn and in winter the self-peeling bark makes attractive patterns on trunk and branches.

Habit and Use: *Stewartia ovata* is a shrub that is rather upright when young, but becomes broad at maturity, reaching 10 to 15 feet in height. *S. Koreana,* growing 45 to 50 feet high, is useful as a specimen tree.

Hardiness: Most of the stewartias are hardy to Zone 5. Reported not to do well in the Midwest. Native to North America and Asia.

Culture: Stewartias do best in a peaty loam; should not be exposed to wind.

Variety: *S. ovata* var. *grandiflora* has purple stamens which are considered by some gardeners to make the flowers more attractive than those of the species, but the leaves of this variety do not develop brilliant autumn coloring, becoming a rather dull purple.

Roche

* * *

Spreading English Yew *Taxus baccata repandens*

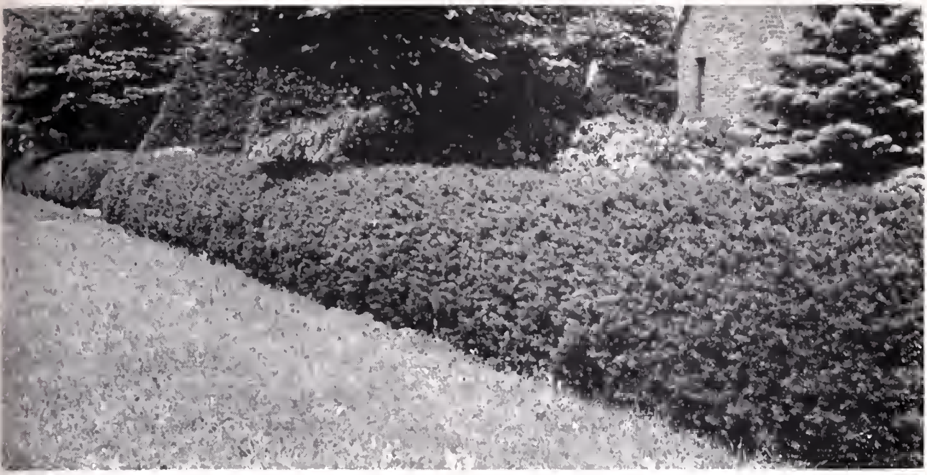
Outstanding Features: The low-spreading habit, dark green luxuriant foliage and ability to grow in heavy shade make this a valuable evergreen.

Habit and Use: Low-growing shrub almost prostrate with long, semi-pendulous, wide-spreading branches. In twenty years or so it is apt to be about 2 feet high, with a spread of 6 feet. Useful in foundation plantings, especially on north sides of buildings.

Hardiness: Hardy to Zone 4. Native to Europe, North Africa and Asia.

Culture: Almost any well-drained soil is satisfactory but light sandy loam is best. Should have partial shade at least. If exposed to sun in winter there is danger of burning.

Buhle



Japanese Yew ***Taxus cuspidata***

Outstanding Features: The beauty of yew lies in the fine texture of its very dark evergreen foliage. The fruits, small waxy red berries, are very attractive against the dark foliage, but they are produced only on female plants.

Habit and Use: Generally used as a shrub, but will grow into a tree up to 50 feet at maturity, densely branching and pyramidal in form. There are many varieties having dwarf, shrubby, columnar, and other habits. Japanese yew and its varieties can be used as specimen shrubs (or trees), for backgrounds, as hedges, and in foundation plantings.

Hardiness: Hardy to Zone 4. Native to Japan and Korea.

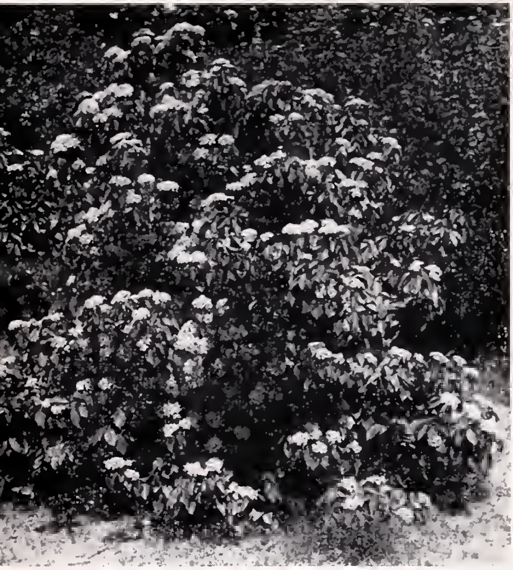
Culture: Yew tolerates a variety of soils, but does best in well drained, light loam. It will grow in sun or shade. Relatively free from pests and diseases.

Varieties: There are many varieties of Japanese yew.

var. *columnaris* is cylindrical in form; var. *nana* is a low, irregularly compact grower, often with picturesque habit; *fastigiata* is a dwarf columnar plant with yellowish leaves; *minima* is very dwarf.

Taxus cuspidata nana

Buhle



Linden viburnum *McFarland*

Linden Viburnum
Viburnum dilatatum

Outstanding Features: In late spring or early summer linden viburnum produces flat clusters of white flowers, rather showy but ill-smelling. These are followed in autumn by clusters of bright red berries which last on the bush for a long time.

Habit and Use: Compact, round-topped bush 7 to 9 feet high. Makes a good specimen plant, and can be planted in shrub borders or in masses. Because of the unpleasant odor of the flowers it is better not to plant too close to the house.

Hardiness: Hardy to Zone 5. Native to Japan.

Culture: Does best in an open situation, in rather moist soil.

* * *

Koreanspice Viburnum
Viburnum carlesi

Outstanding Features: The small, very fragrant flowers of this viburnum, borne in rounded clusters in late spring, are its chief contribution to the garden. The individual florets are pinkish outside, white inside.

Habit and Use: Rounded shrub, rather stiff and open in habit, growing 5 to 6 feet tall. Suitable for shrub border, and unlike many of the viburnums which have ill-smelling flowers or leaves, can be planted close to dwellings.

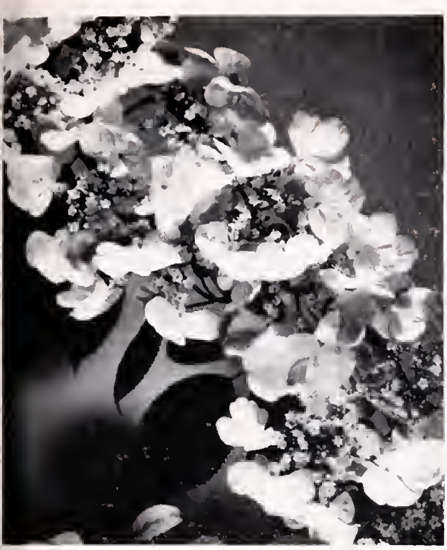
Hardiness: Hardy to about Zone 6. Native to Korea.

Culture: Koreanspice viburnum does well in any good garden soil, fairly moist but well drained, and will grow in the open or in light shade.

Other Kinds: *Viburnum burkwoodi* is a hybrid between *V. carlesi* and *V. utile*. It is very similar to *V. carlesi*, but is more open and sprawling. If pruned carefully it can be kept in a good shape. Its foliage is a darker green, and the plant is a little hardier, surviving in parts of Zone 4.

V. carlecephalum is a hybrid between *V. carlesi* and *V. macrocephalum*. It is similar to *V. carlesi*, with flower clusters 4 to 5 inches across.

Fragrant flowers of Koreanspice viburnum *Roche*



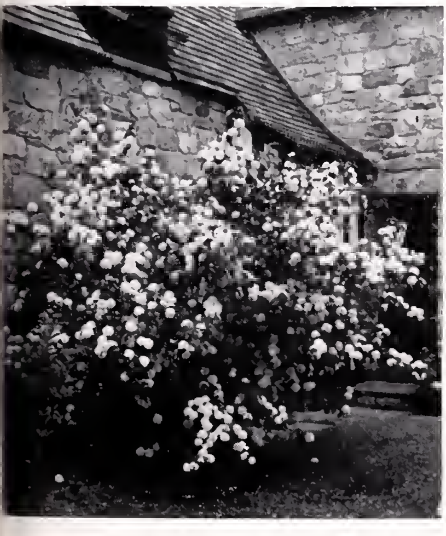
Gantner

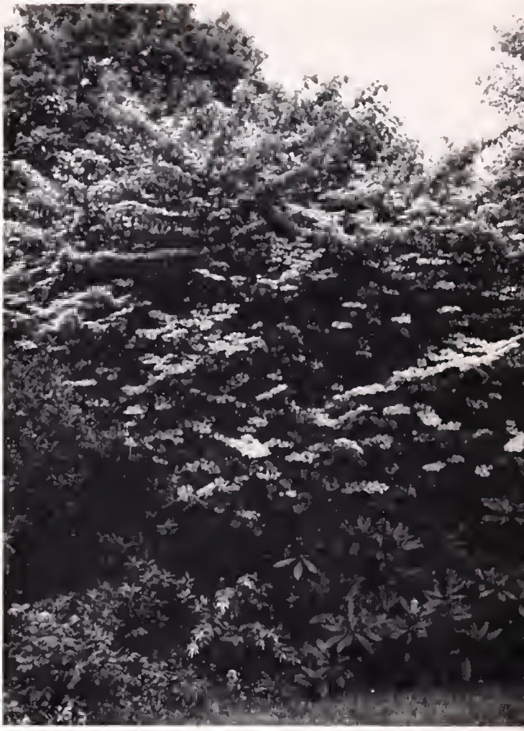
Doublefile Viburnum *Viburnum plicatum* var. *tomentosum*

Outstanding Features: Doublefile viburnum produces flat clusters of white flowers in late spring, often just after the dogwoods have stopped blooming. Their formal regular arrangement along the horizontal branches makes them strikingly beautiful. They are followed in autumn by clusters of fruits, red turning to black and much liked by birds. The foliage takes on a purplish autumn color. There are many other beautiful and noteworthy viburnums.

Japanese snowball

R. A. Smith





Roche

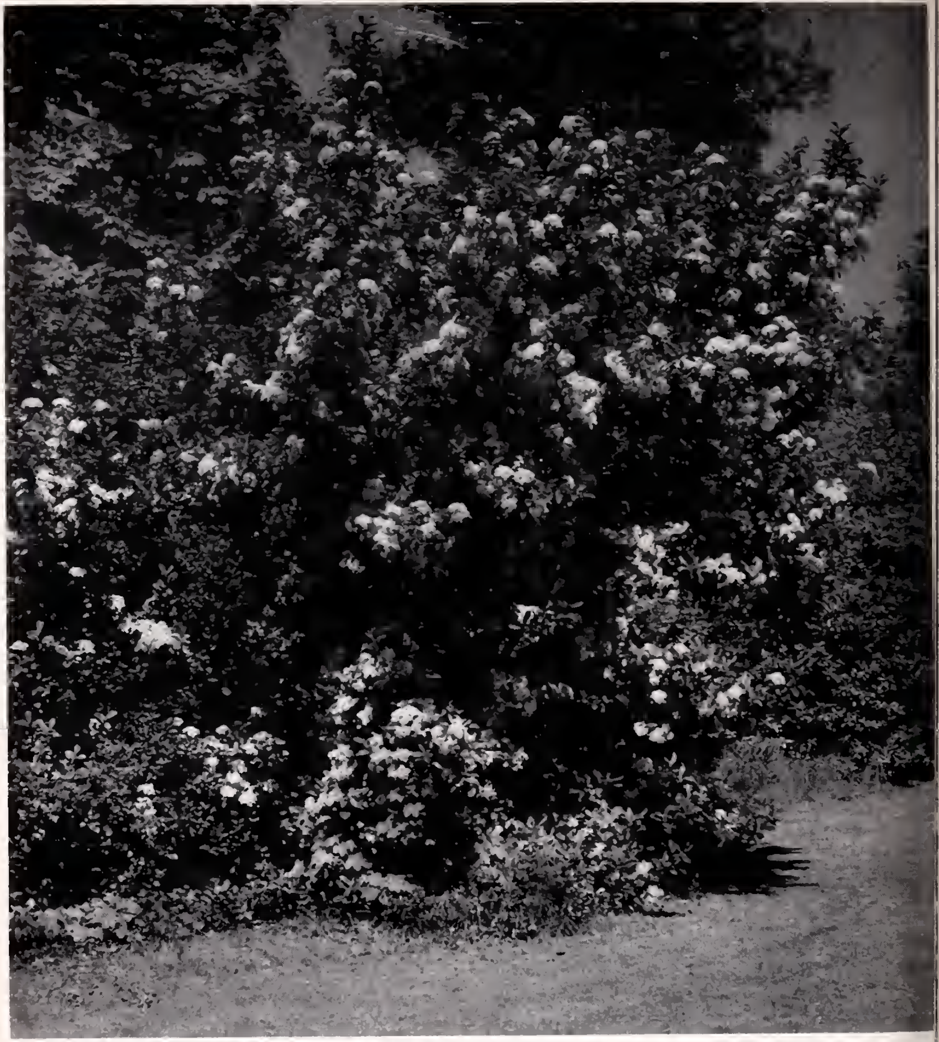
Doublefile viburnum

Habit and Use: A rounded bush growing to 8 or 9 feet in height, but usually less, with distinctive horizontal branching. Can be used in the shrub border, but is better as a specimen plant.

Hardiness: Hardy to Zone 4. Native to Japan and China.

Culture: Most viburnums grow well in any reasonably good soil, but do better if it is on the moist side.

Variety: The popular Japanese snowball is a variety of doublefile viburnum. It is considerably less hardy, and does not grow as large. The flowers are in round, not flat, clusters, and are all sterile, so there are no fruits.



Siebold viburnum

Siebold Viburnum
Viburnum sieboldi

Outstanding Features: This large shrub is one of the handsomest of the viburnums. Its leaves are large, as much as 5 or 6 inches long, and are rich green in color. In early summer it is covered wtih clusters of cream-white flowers, which are followed in fall by attractive fruits. These are black when fully ripe, but display many shades of pink, red and purplish while maturing. Even after they are gone their red stems are colorful.

Habit and Use: Irregularly rounded shrub growing as high as 20 to 30 feet at maturity. Too large for use in borders, it makes an unusually fine specimen shrub.

Hardiness: Hardy to Zone 4. Native to Japan.

Culture: Similar to that for other viburnums.

Buhle

Chaste-tree ***Vitex agnus-castus***

Outstanding Features: The foliage of the chaste-tree is a striking gray-green color and has a sage-like odor. Spikes of lilac or violet-blue flowers are produced in late summer, a time when few other shrubs are in bloom.

Habit and Use: Rather erect, slender shrubs growing about 6 feet tall. Best used as specimen plant.

Hardiness: Hardy to Zone 6. Native to South Europe.

Culture: Will grow in ordinary or even rather poor soil, in open situations. Even where the tops survive the winters, it is usually better to cut the stems back to stubs in the spring, permitting new growth to develop each year.

Variety: Var. *latifolia* is somewhat hardier than the species.

Roche

Japanese Maple

(*Continued from page* 166)

maple, as the names are often confused in the trade. Some nurserymen grow seedlings, selecting the best and giving them the names of established clones which they resemble and which should only be propagated vegetatively.

Silk Tree

(*Continued from page* 167)

cult to transplant. In the southern part of its range it is being attacked by a serious disease, mimosa wilt, for which at present there is no successful treatment. This has not yet reached trees in the northern parts of the range, and it may be that the fungus causing it cannot survive in the North. Some resistant clones have been selected.

Canoe Birch

(*Continued from page* 168)

top as a result of infestation by the bronze birch borer. Gray birch (*B. populifolia*) is sometimes confused with the paper birch, and although it has the interesting characteristic of growing with several trunks in a clump, it is shortlived and decidedly inferior to the paper birch.

European Beech

(*Continued from page* 177)

with deep purple leaves. There are numerous forms of this variety, one with light coppery foliage being the well known "copper" beech.

Weeping beech (var. *pendula*) has long pendent branches; one of the most beautiful weeping trees in the world.

Weeping purple beech (var. *purpureo-pendula*), a striking tree.

Cutleaf European beech (var. *laciniata*) has narrow, almost fern-like leaves. Very beautiful.

Flowering Dogwood

(*Continued from page* 172)

control (see PLANTS & GARDENS, Spring, 1956, page 22). Keeping newly planted trees wrapped with burlap for two or three years after transplanting helps prevent attack. To maintain charming natural form, prune lightly in winter.

Varieties:

var. *rubra* has pink or rose-colored blossoms, best used for contrast with white ones.

var. *xanthocarpa* has yellow colored fruit.

var. *plena* has extra bracts producing the effect of a double flower.

C. florida does not do well on the Pacific coast. Here the Pacific dogwood (*C. nuttalli*) is more satisfactory, and is recognized as a splendid ornamental tree, which when well developed may reach 70 feet or more. The flower clusters have six bracts instead of four as do those of the flowering dogwood.

Russian-olive

(*Continued from page* 176)

Care should be used in selecting Russian-olive plants for good silver color as not all seedlings are equally good in this respect.

Other Kinds:

Elaeagnus umbellata is quite similar to Russian-olive but is a little smaller and has more ornamental red fruit. It is likewise good for seashore plantings.

Witch-hazel

(*Continued from page* 180)

has the largest flowers, appearing in late winter or very early spring. The smaller and duller yellow blossoms of the native witch-hazel (*H. virginiana*) are produced in late fall, at the time the leaves turn. Vernal witch-hazel (*H. vernalis*) has small reddish-tinged flowers in late winter. They are spicily fragrant.

Ginkgo

(*Continued from page* 178)

of soils but good drainage is important. One of its most valuable features is its ability to withstand wind, smog, and city conditions. It will grow in either sun or shade, and is practically free of pests and diseases. It is notably successful in such diverse climates as California, Canada, and the northeastern United States.

Varieties: The sentry ginkgo (var. *fastigiata*) has a narrow columnar habit which makes it useful for planting where space is limited. A weeping form (var. *pendula*). is also available.

Carolina Silverbell

(*Continued from page* 179)

wind. In northern areas the flowers are occasionally subject to late spring frosts; avoid planting in frost pockets. Few pests or diseases.

Other Species and Varieties:

Mountain silverbell (*Halesia monticola*) grows into a substantial tree. The variety *H. monticola rosea* has pinkish flowers. Carolina silverbell and mountain silverbell are reported not to be distinct species, but rather extreme variations of the same species. (See Coker and Totten, TREES OF SOUTHEASTERN UNITED STATES, page 372).

Tulip Tree

(*Continued from page* 185)

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Tulip tree tolerates heat and cold and a variety of soil conditions. Does best in open situations in deep, rich soil. It should have plenty of moisture. Because its roots are deep, this tree is hard to transplant if over three years old. If root pruned a year prior to transplanting, it should offer no special difficulties.

English Holly

(*Continued from page* 181)

development the trees should have summer sun (see comments under hardiness). Holly withstands severe pruning at almost any season. It is most convenient to do this when collecting berried branches for winter decoration. The sexes are separate in English holly, so male trees must be grown nearby if berries are to be borne on female trees. For fertilization, see comments under American holly.

Varieties: There are innumerable varieties, many of which are less desirable novelties.

Goldenrain Tree

(*Continued from page* 180)

may be questioned.

Hardiness: Hardy to Zone 5. Native to China, Korea and Japan.

Culture: One of its most valuable traits is its adaptability to a large range of soils and situations. It should, however, have full sun; in shade it may become straggly. Relatively free from pests and diseases; withstands drought and hot winds. Rather short lived.

Saucer Magnolia

(*Continued from page* 186)

grown with protection in parts of Zone 4. Hybrid, parents native to China.

Culture: Thrives in a fertile, moist soil in full sun or partial shade; is tolerant of less desirable infertile soils. Difficult to transplant any but smaller specimens but if root-pruned a year before transplanting, should offer no difficulty. Best if moved in early spring. Requires no pruning.

Varieties: Several, in a range of colors. Not to be overlooked is the Yulan magnolia (*M. denudata*) which is one of the parents of the saucer magnolia, and has about the same growth habit. Its cream-colored blossoms appear in early spring, before the leaves.

Southern Magnolia

(*Continued from page* 186)

mens are growing as far north as Long Island, but the foliage is damaged somewhat each winter. For best growth, soil should be deep, moist and fertile. Should have an open exposure with plenty of summer sun. In cooler climates, the planting site should be carefully selected for wind protection and reasonably full winter shade.

Swiss Stone Pine

(*Continued from page* 191)

The branches are very dense, short and thick. The dark green needles are in bundles of 5 and of soft texture. This tree, because of its upright regular habit, can be used for formal plantings where it has plenty of space and sun. Although very slow growing, it should not be used adjacent to small buildings.

Hardiness: Hardy to Zone 2. Native to Europe and northern Asia.

Culture: The Swiss stone pine grows best in a well drained loamy soil on hillsides, in full sun.

White Pine

(*Continued from page* 191)

an asymmetrical, picturesque appearance as a result of losing their terminal leader when young. The tree can be restrained for small plantings by judicious pruning, and is not infrequently used as a hedge (in full sun). A superb specimen tree, it can also be used to provide a fine evergreen background for other plantings, such as flowering dogwood.

Hardiness: Hardy to Zone 3. Native to eastern North America.

Culture: White pine will grow in most well drained soils whether impoverished or fertile. They do not reach their best development in limestone soils. Full sun is needed. One serious disease is to be guarded against: white pine blister rust. As it is carried by many types of currants, which serve as alternate hosts to the disease, these bushes should be eliminated within ¼ to ½ mile of pine plantings. A serious pest in some areas is the white pine weevil, which causes death of the terminal shoots. Early season spray of highly concentrated arsenate of lead (applied to the tip buds) will control this pest. In pruning white pine, the pine "candles" should be pinched back while still young and brittle. Next year's buds will form anew on the broken ends.

Variety: var. *fastigiata*, with narrow, pyramidal habit, is especially good for screen plantings.

Sour-gum

(*Continued from page* 190)

Hardiness: Hardy to Zone 4. Native to eastern and southern United States.

Culture: Does best in moist or wet soil in full sun. Relatively free from pests and diseases. Difficult to transplant, and even small specimens should be root-pruned for two successive years before any attempt is made to transplant them. The fruit is of little or no interest, so the separate sexes are of no importance in planting.

Japanese Flowering Crab-apple

(*Continued from page* 188)

feet. Densely branched and rounded in form, they make fine specimen plants.

Hardiness: Hardy to Zone 4. Probably native to Japan or China.

The oriental crab-apples, of which this is one, are not susceptible to cedar-apple rust or fire-blight which are troublesome with native American species.

Dawn-redwood

(*Continued from page* 190)

tility, has grown to 25 feet in height in ten years, yet has kept its relatively compact pyramidal growth habit. Does well in full sun.

Japanese Weeping Cherry

(*Continued from page* 194)

Culture: As for *Prunus serrulata.*

Other varieties: The variety of *P. subhirtella pendula* called YAE-SHIDARE-HIGAN has double flowers. *P. subhirtella* var. *autumnalis*, the fall-flowering or twice-flowering cherry has larger flowers than the weeping form, but they are produced less abundantly. In mild weather in late fall or early winter a scattering of the blossoms may open, though there are not as many as appear in the spring.

Golden-larch

(*Continued from page* 194)

Other Larches: The weeping European larch, a true larch (*Larix decidua* var. *pendula*) excels all larches in its graceful appearance, yet lacks some of the qualities of the golden-larch.

White Oak

(*Continued from page* 195)

Culture: Because of the fact that it is difficult to transplant and that it grows very slowly, it is not in cultivation to any great extent and is often substituted for by trees of the red oak group, which grow faster and are easier to transplant—but lack the inherent beauty of the white oak. Once established, white oak is very tolerant as to soil conditions but does best in a well drained loam soil with plenty of sun. As with other oaks, white oak is bothered by a number of diseases and insect pests.

Mountain-laurel

(*Continued from page* 222)

light and sandy. Can be grown in shade, but needs sun for good flower production. Should be severely pruned back when moved, otherwise needs little pruning from year to year. Since it has a shallow root system a light mulch is desirable.

Giant Sequoia

(*Continued from page* 197)

redwood and with care can be grown over a much greater area (see comments in PLANTS & GARDENS, Vol. 7, p. 113). It prefers moist, rich, deep soil and moist atmosphere. In colder parts of the range it should be protected from wind and from drying out in winter. This is especially important where the ground freezes, and while the tree is young. After the roots have reached depths below the frost level, damage from winter drying is much less. Like redwood, sequoia is remarkably free from pests and diseases.

Abelia

(*Continued from page* 205)

shrub for the border, for foundation plantings, or it may be used as an informal hedge (not sheared).

Hardiness: Hardy to Zone 6; can be treated as a cut-back shrub in colder areas. Hybrid, parents native to China.

Culture: Abelia will grow in any reasonably good soil, in full sun or light shade.

Bearberry

(*Continued from page* 205)

places, in rock gardens, and for binding sandy soils. Very useful for seashore plantings.

Hardiness: Hardy to Zone 2. Native to Europe, Northern Asia and North America.

Culture: Grows well only in poor, sandy soils, and does best in full sun. Does very well at the seashore.

Bald-cypress

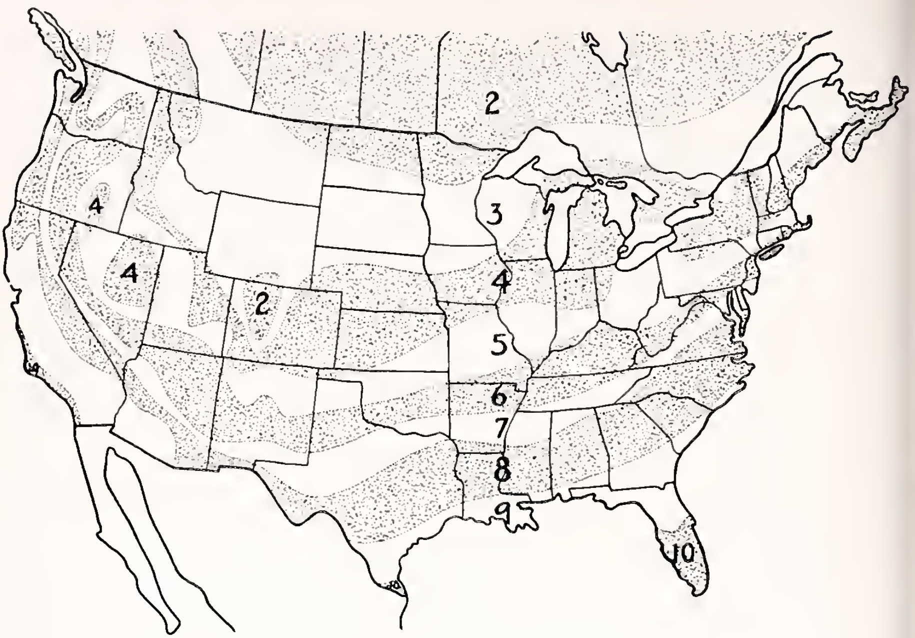
(*Continued from page* 199)

where few other trees can grow.

Hardiness: Hardy to Zone 4. Native to southern United States.

Culture: Bald-cypress will grow in any soil, whether wet or dry, and over a very wide range of climate.

MAP SHOWING ZONES OF HARDINESS IN THE UNITED STATES



The limits of the average annual minimum temperatures for each zone.

Zone 1	In Northern Canada	Zone 6	− 5° to 5° F.
Zone 2	−50° to −35° F.	Zone 7	5° to 10° F.
Zone 3	−35° to −20° F.	Zone 8	10° to 20° F.
Zone 4	−20° to −10° F.	Zone 9	20° to 30° F.
Zone 5	−10° to − 5° F.	Zone 10	30° to 40° F.

Compiled by the Arnold Arboretum, August 1, 1948

In using the zone map it must be kept in mind that the zones are only approximate, and that there are many variations within each zone. Altitude and exposure can result in a climate quite different from the "average climate" of any given region. A wide range of climates may exist even within the confines of a single garden—and the alert gardener will seek these out and make use of them to successfully grow plants far outside their commonly accepted range.

* * *

Among the many excellent books on trees and shrubs that are available, Donald Wyman's Trees for American Gardens and Shrubs and Vines for American Gardens are outstanding.

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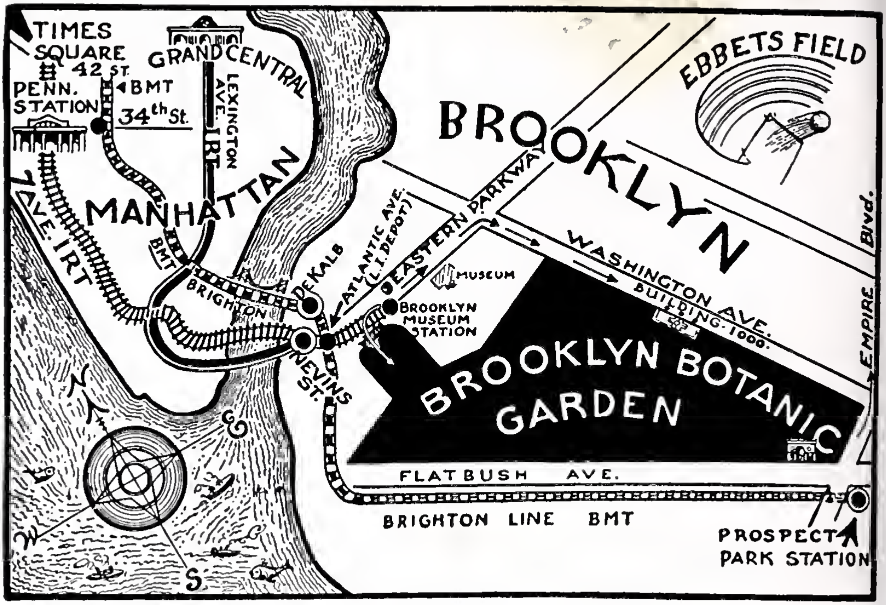

TO REACH THE GARDEN

By Subway

B.M.T. (Brighton Beach line) downtown express or local to Prospect Park Station.

I.R.T., West Side (7th Avenue or Broadway-7th Avenue line) downtown express marked "New Lots Avenue" or "Flatbush Avenue," to Eastern Parkway-Brooklyn Museum Station.

I.R.T., East Side (Lexington Avenue line) downtown express marked "New Lots Avenue" or "Utica Avenue" or "Atlantic Avenue," to Nevins Street; step across platform and change to 7th Avenue or Broadway-7th Avenue train, ride to Eastern Parkway-Brooklyn Museum Station.

By Bus

Flatbush Avenue bus to Empire Boulevard

Lorimer Street bus Tompkins Avenue bus	To Flatbush Avenue
Union Street bus Vanderbilt Avenue bus	To Prospect Park Plaza

By Automobile

From Long Island, take Eastern Parkway westward, and turn left at Washingto Avenue.

From Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway; follow the Parkway to Washingto Avenue, then turn right.

BROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

WINTER
1957-58

The
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in
Gardening
and
orticulture

Guide to
Recent
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s and Articles
Gardeners

EW SERIES
13 No. 4

AMONG THE CONTRIBUTORS TO THIS ISSUE

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Yuji Yoshimura, bonsai expert, co-author of *The Japanese Art of Miniature Tre and Landscapes*, and proprietor of Kofu-en Bonsai Nursery and School, Toky Japan.

Numerous readers have written in to ask where they can buy mulching materials. As a readily available commercial item, a long-time friend of the Botanic Garden has recommended STAYZ DRY; we have made tests, and agr that it is very satisfactory. It is available as poultry litter from feed stores, generally at $2.25 to $2.50 per bale. Not sold at Brooklyn Botanic Garden.

PLANTS & GARDENS

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Editorial

Peter K. Nelson, *Associate Editor*

Conrad Link

and the Editorial Committee of the Brooklyn Botanic Garden

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ublished quarterly at 3110 Elm Avenue, Baltimore, Md., by the **Brooklyn Botanic Garden, rooklyn 25, N. Y.** Entered as second-class matter at the post-office at Baltimore, Md., nder act of August 24, 1912. Subscription included in Botanic Garden membership dues. o others: $2.00 per year; $3.75 for two years.

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NOTICE OF CHANGE OF ADDRESS AND ALL OTHER CORRESPONDENCE
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BROOKLYN BOTANIC GARDEN, BROOKLYN 25, N. Y.

Winter comes to the Fragrance Garden.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
BROOKLYN BOTANIC GARDEN
1000 WASHINGTON AVENUE
BROOKLYN 25, NEW YORK
TELEPHONE: MAIN 2-4433

Winter 1957/58

This is the thirteenth season (since 1945) that our Editorial Committee has made its annual selection of special "articles-of-the-year." Our objective, as long-time readers so well know, is to choose what seems to us the year's outstanding contributions of 1) new factual information of importance in gardening and horticulture, and 2) articles that have idea-value in our field, and are therefore of significance over the longer term.

It is a great pleasure to thank authors, editors and publishers for their warm cooperation in making it possible for us to present these fine year-end selections—the Brooklyn Botanic Garden's way of awarding intangible "Pulitzer Prizes" in the field of gardening and horticulture.

In the universal avocation of gardening there is something for every age and economic level. The articles range from Happy Children . . . and Golden Age Gardeners . . . to Poison Ivy, Gibberellin, and The Dying Oaks. Most of these articles are presented in condensed form. Occasionally we select an excerpt from a book—this year from one on Bonsai, written jointly by a Japanese nurseryman and his English student in bonsai culture.

The billboard subject crops up from time to time, and although the article by Inez Robb stands firmly on its own, readers may be interested to know that roadside billboards have been outlawed in Denmark for the past fifty years!

Among the four articles that appear in print for the first time in this issue, one concerns the outstanding trees and shrubs for California and similar climates. This has been included to round out our presentation (in the autumn issue) of the "Rembrandts" of the plant world.

We are particularly happy to call your attention to our experience with electrically heated greenhouses. For the uses this article points out, we find them just about the ideal answer.

There is another article, one on which we solicit your response. It is about starting botanic gardens or arboretums in thousands of cities and towns—where they could serve in a role fully as important as that of public libraries. This article is a brief version of an earlier one that was written primarily for botanists and for those who are presently administering public gardens and arboretums. If the earlier, more complete article would be of interest, feel free to write for a reprint; it is yours for the asking.

With every good wish for the New Year.

Sincerely,

George S. Avery, Jr.

Director

WHY NOT A BOTANIC GARDEN OR ARBORETUM FOR YOUR COMMUNITY?

George S. Avery, Jr.

A STEP TOWARD BETTER GENERAL EDUCATION

What if most Americans could recognize 100 or more kinds of fine ornamental plants, and knew how to grow them to the peak of perfection in their gardens? And what if they knew at least the most common trees of the forest and plants of the roadside, and something of their natural association and succession? The better appreciation of nature that would come with it could be a giant step toward greater human enjoyment, and toward reaffirming faith that civilization's riches still spring from the earth.

EVEN the most casual follower of the news, whether in the newspapers or news magazines, continually discovers and rediscovers disturbing accounts of present-day life—the missiles race, what's wrong with American schools, economic aid to backward (and other) nations, foreign policy in the Near East, and a dozen other subjects about which most of us can't do anything and about which it is frequently difficult even to have an intelligent opinion.

There can be little doubt about the importance of these matters. Yet if we are to be continually absorbed with affairs beyond the control of ordinary people, our community life will suffer correspondingly. It is too easy to forget or to overlook the homefront. Not enough of us are working in an organized way to make life-enriching opportunities available in our home communities. I remember a number of years ago asking several representative citizens in a small New England city just what they would look for i they were moving to a new place. A agreed that it must be a town with goo schools and good municipal services; tha it must also offer economic opportunitie A minister added that he wanted diversified industry in his ideal city, because h sought a greater variety of conversatio in his pastoral calls. He once had a parish in a shoe town in Massachusetts wher all the talk was of shoes. But there wa still another requirement on which the all concurred. The new town of thei choice had to be beautiful. It must hav nice parks and attractive tree-lined street —things that provide a partial answer t man's fundamental urge to pursue th beautiful.

Today's Leisure

Thoughtful citizens continually reap praise their communities. The basic municipal services of providing schools, police and fire protection, water supply an

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Brooklyn Botanic Garden, in the heart of a vast metropolitan area, fills the need for beauty, recreation and education for thousands of citizens. In smaller communities botanic gardens on a simpler level can play an equally important role.

garbage collection necessarily come up for major attention. But what of the "better life ” In this mid-20th-century America, our industrial economy and resultant urban living have freed the greater part of the population from the endless chores that once kept most people from pursuing cultural interests. The 40-hour, Saturday-free week, coupled with labor-saving gadgets and greater average income, has produced so much leisure that millions sit by the hour watching television. Granted, some of it is excellent; but God help us both as a nation and individually if TV gets more than its proper share of people's leisure time. TV may provide entertainment and instruction of a passive sort, but it is debatable whether it can build or maintain a culture, or create a constructive tradition. In short, increasing freedom from gainful occupation, resulting from the technical developments of our time, has brought us into the midst of a social revolution that could easily lead to cultural impoverishment.

A Universal Avocation

How can we steer our course through these unstable years and emerge the richer for it?—not richer in dollars or material things, but richer in mind and spirit. There may be many possible answers to the questions posed; but for me, the answer must include better informed avocational interest in the plant world for people in all walks of life. Working with plants probably comes nearest to being *the* universal avocation. Yet comparatively few people either with or without so-called higher education have even a simple basic knowledge of plants. The lower schools do not teach it, and the colleges and universities are at present more concerned with scientific studies of plants. Even if all the 100 or so botanic gardens and arboretums in North America were to set up programs of instruction at the popular level, only a fragment of the potentially interested population could be reached.

The leadership and greatest impetus for the development of this phase of our life is now coming from more than 500,000 members of Garden Clubs all over the U.S.A.—eager amateurs who are, in effect, trying to help America along the road to a pattern of maturity. These plant-minded and community-spirited people are working unselfishly toward better and more attractive towns and cities in which to live, and lovelier gardens for their homes and the human spirit.

It is rewarding to work with one's hands, especially with growing things. There is a fascination and a challenge in the very act of starting something that can grow to be beautiful. Not everyone can be a successful painter or musician, but everyone *can* plant a seed and spend happy hours and days keeping watch over the fragile life that springs from it. One of my physician friends tells me he finds personal peace in growing orchids. Millions of people in all walks of life find satisfaction in similar simple pursuits of growing living things. Most of them could never paint on canvas with brush and pigment, but they can rear living masterpieces. The self-administered therapy that comes from such experience provides almost the only link between man and nature for a goodly percentage of our population.

How Can Botanic Gardens Be Effective?

Now, what can we do to put this inner urge of millions on a broader base? Having seen the Brooklyn Botanic Garden and Arboretum in action for many years, I am convinced that every community of reasonable size should have at least a small arboretum or botanic garden of its own. With sympathetic planning by private citizens and public officials, many cities and towns could have them—perhaps establish them in existing parks. Indeed, several such situations already exist. *But, if they are to be effective,* and help people toward greater creative interest in their everyday lives, the gardens and arboretums must be more than labeled displays. As it is, they are apt to be mere collections of things, often poorly landscaped. *Ideas* are more important, and must come first. So the botanic gardens and arboretums that I envisage in the towns and cities of America must be under the guidance of people with at least a little experience in education, and some training in botany and horticulture. They should be able to set up popular courses for interested laymen, and thus put the

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An adult class at the Brooklyn Botanic Garden gains horticultural know-how by planting miniature gardens.

living plant collections to work. Some communities are trying for this goal through garden centers, and these may well be the first step toward developments of greater scope. But whatever the framework, without *a popular education program,* garden centers, arboretums or botanic gardens can be of little real consequence in the communities in which they are situated.*

Why not a botanic garden or arboretum for your community, and one with an active program associated with it? As America continues to grow, so will the need for popularly slanted cultural institutions such as these. They can be both useful and beautiful—priceless assets to life in any community.

---

*A survey of the approximately 100 existing public gardens and arboretums in Canada and the United States shows that so far as we know, only 6 offer popular education courses. Perhaps this is the explanation for the lack of increase in the numbers of such gardens in America at the present time. In the same century that botanic gardens have crept up to the hundred mark, public libraries have grown to a total of more than 6,000!

FOR STARTING AN ARBORETUM OR BOTANIC GARDEN YOU SHOULD HAVE:

- The backing of interested and influential local citizens.
- A sympathetic local government; one that can envision the importance of strengthening the community beyond furnishing routine public services.
- Land, preferably located in or near a populated area. This might be a half-acre or many acres; a modest start is best, with adjacent land available for expansion.
- A supervisory "key" person with proper training and preferably some experience.
- Funds in sight for the first three to five years. Modest municipal funds (from tax budget) matched by gift funds from generous individual and supporting organizations are a good basis for support.
- Sponsoring organization (s). Chamber of commerce and service clubs are as interested as garden clubs in backing projects that will make their communities outstanding for visitors as well as residents.

These are the basic ingredients for starting the project. A visit to one of the gardens with actively working programs in popular education, for both children and adults, will supply suggestions for adapting to the needs of your own community. The Brooklyn Botanic Garden has had long experience with such a program and will be glad to help, wherever possible. Letters should be addressed to Brooklyn Botanic Garden, Brooklyn 25, New York.

A general view of work activity at "The Hilltop."

HAPPY CHILDREN GROW IN GARDENS

The lives of hundreds of youngsters have been enriched by Bloomington, Indiana's, junior gardening program. Your town or even a group of neighborhood parents, could copy it

Dan O'Connor

Condensed from *Better Homes and Gardens*, May, 1957

ONE night early last spring, Mike, our 10-year-old-son, stopped momentarily in his after-dinner rush to get outdoors. "Mother," he asked easually, "can Pat and I be Junior Gardeners this year?"

My wife, Dorothy, sensing no great harm in the idea, though as ignorant as I at the time of the Bloomington Junior Gardening Workshop, said, "I guess so."

Taking her reply as complete and unalterable permission, Mike and Pat grabbed their baseball mitts and slammed the back door behind them.

As soon as my head stopped quivering from the vibrations, I asked, "Junio Gardening . . . what's that?"

"I don't know," my wife replied, "bu they must have heard about it in schoo today."

Little did Dorothy and I realize that in the months to follow, Junior Gardening would bring about so much change on th family scene and in our sons.

For the first time in their lives, th boys became intensely interested in th world of nature, discovering wonderfu new things about vegetables, flowers, an

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insects. They volunteered to work with Dorothy in her flower garden and with me in my small tomato patch—indeed, a novel situation—instructing both of us in the lessons they had learned.

Our summer mealtimes acquired an atmosphere of relative peace and relaxation, largely because the boys could point proudly to the food on the plates before us all as their broccoli, their beets, their onions, and other produce they raised on the "Hilltop" overlooking Bloomington, Indiana.

Indoor Activity

Shortly after their teachers announced the program, Mike and Pat reported to the Community Center for several Saturday mornings of "indoor gardening." Here, with approximately 150 other 9- to 12-year-old boys and girls, they had their first taste of the unusual combination of work and fun which characterizes all phases of Junior Gardening.

Their indoor introduction consisted of viewing films on the different phases of garden preparation and care, studying the the model garden layout to get an idea of how their own garden would eventually appear, planning on paper their own 10 x 10-foot garden, and taking certain tests. Surprisingly, even the tests were fun, especially for our younger son, Pat.

In addition to the excitement of acquiring new knowledge, the indoor gardening periods were filled with other kinds of fun. The boys made many new friends from schools throughout the city. They enjoyed the keen interest of their adult garden leaders, and they played games and sang songs with the other children.

Early in April, before the Junior Gardeners moved outdoors, adults did the heavy work of preparing the soil at the Hilltop for planting.

Although spared these heavier burdens of making ready the winter-hardened soil, the children did the final preparation, hoeing and raking it their first day at the Hilltop. In this way they learned, through perspiration as well as indoor study, that seeds require a soft bed in order to germinate quickly and grow into a fine healthy crop.

Cultivating a sense of teamwork, as well as the soil around their beans, in their town's junior gardening project.

Outdoor Preparation

On the first "outdoor" in mid-April, the children arrived at the Hilltop by special bus, bicycle or family car. Those who had not been in the program before quickly surveyed the layout. A full acre plot of elevated land had the vegetable area in the center surrounded by attractive herb, water, and flower gardens, handsome fruit trees and evergreens, greenhouse and tool house, and a "council ring" shaded by Lombardy poplars. A tall iron fence surrounding the entire plot held rambling roses which bloomed magnificently during much of the summer.

The young gardeners learn the names of the tools and how to use them; to protect themselves and others from injury by the tools; and how to scrape dirt from tools and wipe clean before putting away.

Beckrich photos

Beckrich

Weighing in and recording the day's harvest is most gratifying to the children, although end-of-season awards are made chiefly for cooperative endeavor rather than for the quantity of garden output.

Each day at the Hilltop begins in the council ring. Here, the children are reminded of pertinent lessons received at the Community Center and receive their assignments for the day. They are given opportunities to volunteer for work outside their vegetable plot.

After a friendly council meeting, work starts. Two children are assigned to each garden.

On soil-preparation day, Mike and Pat, sharing a plot, took turns hoeing the soil which had been packed down by the spring rains, after it had been harrowed. Then, Mike raked out the clods while Pat removed the weeds and placed them in a wheelbarrow. Finally, to return to the soil the minerals used up by last year's crop, Mike sprinkled on fertilizer while Pat raked it into the soil.

For any two children to cooperate in this manner is unusual. For two brothers to get along with efficiency and harmony during such labors is indeed a miracle.

It is just this kind of miracle that Dr. Barbara Shalucha, founder of the Junior Garden Workshop, had in mind when she instituted a program that would enable "children to grow in gardens."

Cooperation Stressed

Cooperative effort is the keynote, also, in all work done by the children outside their own vegetable gardens, and there is much such work to be done.

For time spent in these tasks, the children can accumulate "honor points" which at the end of the season may win them special recognition. Awards for good gardening include ribbons, a National Garden Institute medal, and the engraving of the best gardener's name on a plaque maintained by the Indiana University Botany Department.

The honor activity which has been the most meaningful to our older boy, Mike, has been that of playing "teacher." One day, after having passed his own flower test by properly identifying at least 10 of the plants growing within the grounds, he received permission from an adult supervisor to run other children through their flower tests.

Planting

One day in late spring, the children receive the order: "Go ahead, plant"—music to their ears after weeks of garden planning and soil preparation! With their paper plan pegged to a spare spot on their plot, partners prepared to seed their garden.

First, with the aid of a garden line and a field ruler, they mark off their rows for planting. Then they obtain their seeds from labeled containers nearby and plants from the greenhouse.

Next, into the soil go seeds and plants, all according to depth and distance apart as shown in their garden plan.

Planting continues over a period of several sessions, for the children have learned to put their cool-weather crops in first and their warm-weather crops last. In addition, they have learned that beans and radishes are succession crops; that is, they will be harvested early, making room for later plantings and a full garden all summer long.

After planting time, the children do no watering of their gardens. During a typical summer in southern Indiana, the rainfall is sufficient to ensure adequate harvest.

Harvest

Harvest time, which begins quite early because of careful planning and the use of well-fertilized soil, is most gratifying to the children. Everything they reap is weighed and recorded at the weighing station before being brought home. Although the awards at the end of the season are made chiefly for cooperative endeavor rather than quantity of garden output, the record book provides the leaders with evidence of industry and interest.

If any competition exists in the weighing-in, it is not so much competition with fellow-gardeners during any one year as it is with the group output of previous years. In this kind of competition, everyone can engage wholesomely.

Perhaps the happiest harvest is the smiles when the children dash radiantly into their homes, crop baskets in arm. June, July, and August, the excitement never wears thin.

During the past 9 years, the Junior Garden Workshop has provided Dr. Shalucha and her colleagues with an opportunity to try out and continually improve an activity which could be emulated in communities throughout the nation. In addition, it has added breadth and richness to the lives of hundreds of small children.

It has fostered a sense of leadership in both our boys and helped develop their understanding of cooperation at home and elsewhere. It has awakened them to the phenomena of nature.

But, granting all these values, parents in other communities may reply, "How could we put a similar program into effect? We have no state university to supply the land as Bloomington does. We have no city recreation department to provide leaders and a community building for the indoor program. We have no garden club to build us a greenhouse and to supply trees and shrubs. We have no money for dozens of hoes, rakes, and shovels, nor for a building in which to store them. What's more, even if we had all these facilities, we couldn't find anyone to organize a program—anyone, that is, who has a great deal of know-how about both gardening and children."

During the first summer at Bloomington, the enrollment was 17 children—not 150, as it is now. Equally inauspicious beginnings could be made elsewhere.

Any Community Can Have a Junior Garden

There is no reason why a group of neighborhood families could not organize their own program, if there is an empty lot to be had and the right kind of leadership to be found. For the indoor gardening activity, a family living room or recreation room could replace the community center.

On a weekend, the fathers could clear that empty lot of brush and spade the soil in preparation for use by the children. For a few dimes from each family, enough seed could be purchased to start the first year's crop, and after that seeds could be saved from the previous year's crop harvest. The families could pool their tools and, given the right kind of leadership, the tools would be returned after each session, dirt-free, oiled, and in one piece.

Needless to say, the success of such a program depends far more on leadership than it does on land, tools, and seeds. But who would be a good leader for a children's gardening activity?

Actually, an enthusiastic "den mother," scout leader, or elementary teacher could do the job, whether or not he or she had an extensive background in botany or small-scale farming. What a leader lacks in know-how, he could make up for in vivacity and common sense.

Beckric

The children can earn "honor points" for work done outside their own vegetable gardens. Herb, water, and flower gardens must be trimmed and weeded, and gardens of absent boys and girls are tended.

If he wanted to "bone up" on the principles of gardening before undertaking such a program, he could write to the Department of Agriculture in Washington, D. C., for its free series of home and garden bulletins. Two of these booklets would prove especially useful: Bulletin No. 7 ("Growing Vegetables in Town and City"), and Bulletin No. 9 ("Suburban and Farm Vegetable Gardens").

And here is a list to help junior gardeners plan their vegetable or flower plots:

Cool-season vegetables

Name	Estimated days seed to harvest
Lettuce, leaf	30-45
Radishes	30-35
Peas	65-75
Onion	seed 120-140 sets 100-120
Turnip	60-80
Beets	50-60
Carrots	70-75
Broccoli*	60

Warm-season vegetables

Name	Estimated days seed to harvest
Bush beans	50-60
Bush lima beans	75-80
Tomatoes*	115
Pepper*	115
Eggplant*	125
Cucumber	45-75
Butternut squash	100
Sweet corn	75-90

*Buy plants instead of seeds

Flowers

Name	Estimated days seed to earliest bloom
Nasturtium	65-80
Gourds**	——
French marigolds	65-80
Petunias*	30-45
Zinnias	45-55
Pinks	65-80
Gaillardia	45-60
Sweet alyssum	45-55
Portulaca	45-60
Snapdragon*	45-60

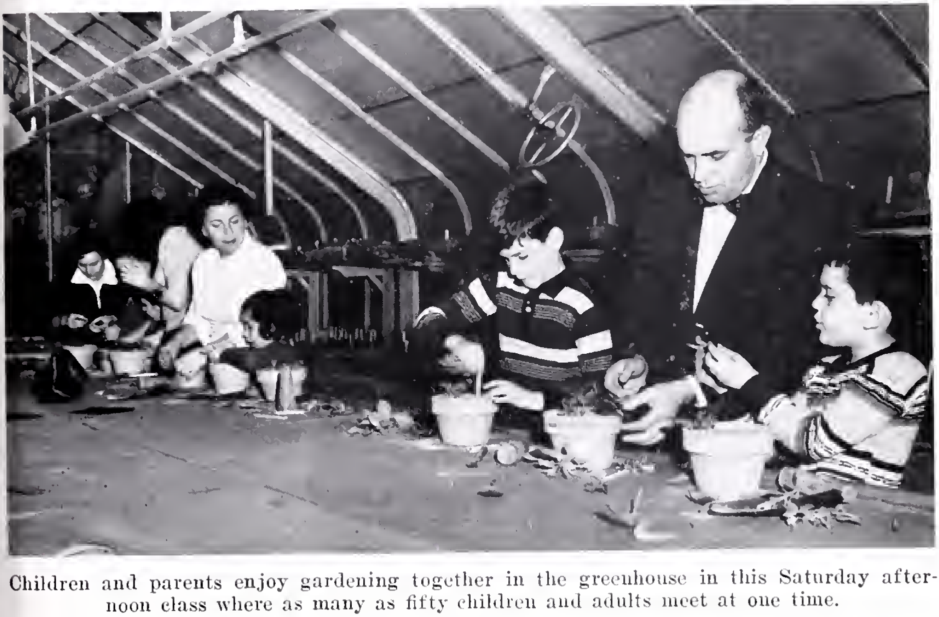
* Buy plants instead of seeds—set when soil is warm

** Use fence or other support

For a free copy of the garden handbook used in the Bloomington program a leader could write to: Dr. Barbar Shalucha, Botany Department, Indian University, at Bloomington, Indiana. Or for experience in urban communities write Mr. Paul Young, Board of Education, Cleveland, Ohio, or Miss Frances Miner, Brooklyn Botanic Garden—wher children's garden programs have bee similarly successful for over 40 years.

Here are two of four hundred youngsters (in their honor point garden) in an urban Children's Garden program.

Mamay photos



Children and parents enjoy gardening together in the greenhouse in this Saturday afternoon class where as many as fifty children and adults meet at one time.

AN INEXPENSIVE GREENHOUSE HEATING SYSTEM

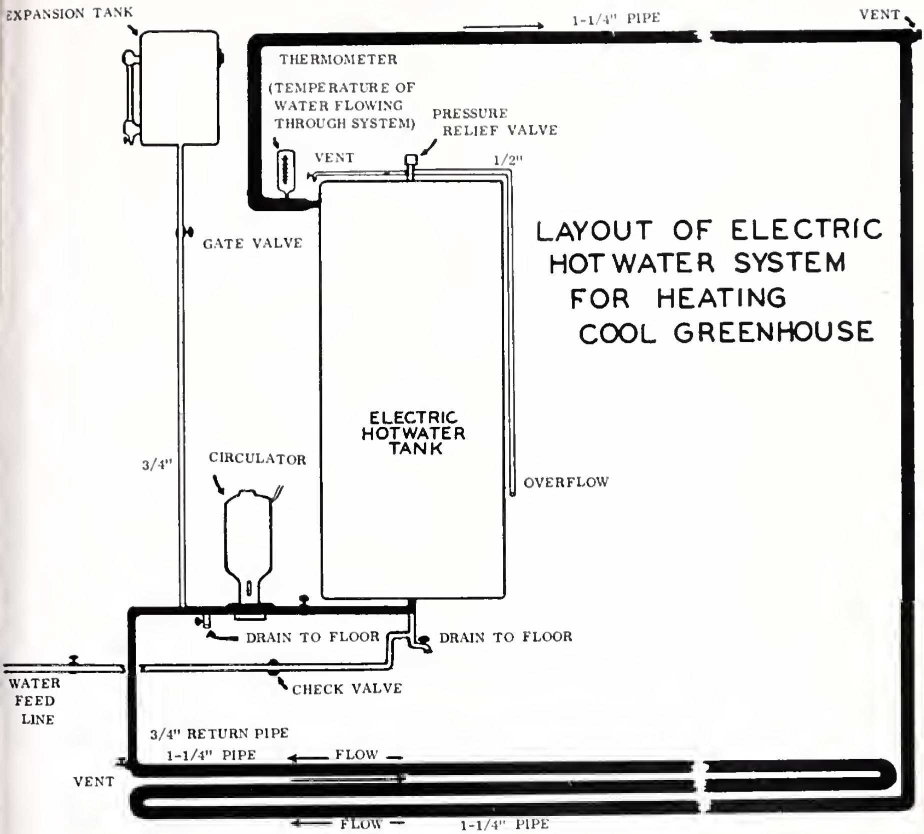
Unconventional use of home electric water heater solves problem of cool greenhouse—a report from the Botanic Garden staff

A NUMBER of years ago the horticultural staff here at the Brooklyn Botanic Garden felt that its greatest need was for a small "cold greenhouse," a greenhouse in which winter temperatures would stay low, but never go below freezing even at night, and which would be warmed to good growing temperatures by winter sun in daytime. Everyone with greenhouse experience knows how well all but tropical plants grow under such circumstances.

The obvious answer to such a need was a "pit" greenhouse, yet for reasons that need not be explained here, a pit greenhouse was not a practical solution at the Botanic Garden. Next best was a semi-pit structure, and a good friend of the Garden made it financially possible to erect one. Except for sudden cold snaps, i worked well, particularly when the glas was covered with insulating material a night. An occasional unexpected freez took its toll of the more tender plants Answers were gradually worked out t all the problems except "freeze insurance' —yet we neither wanted nor needed a orthodox heating system. All that wa necessary was a heat reserve that coul be tapped on cold winter nights, and days when temperatures stayed well belov freezing — days when clouds would kee the winter sun from doing its job.

This semi-pit greenhouse has a dirt floor 2 feet below ground level.

It was at the time of greatest need fo a solution to the problem that a membe of our staff chanced to visit a special holly propagating greenhouse belonging to the New Jersey Silica Sand Company, in Millville, New Jersey. Here he found the answer to our problem of a "heat reserve" that could be drawn upon as needed, yet one that required no heater with fire or fumes, no chimney, no "boiler room," no man power. It consisted of a large-size domestic electric water heater, which served as the boiler. To this was connected a simple hot water coil system through which a home-sized electric circulator pump forced hot water when the thermostat gave the word. An electric cable provided bottom heat in two propagation benches. This system was installed in a greenhouse 45 feet long and 22 feet wide, constructed of cold frame sash. The floor of the house was 40 inches below ground level. The lowest temperature

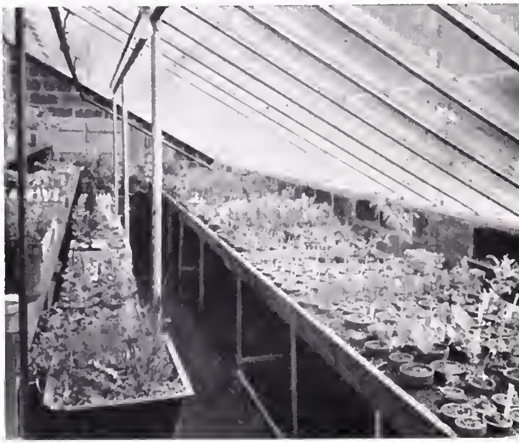


Plan of heating system.

recorded in the greenhouse was 38° F. on a windy night when the outside temperature was 0° F.

Installation

Here indeed was the heat reserve we had sought. The news was hurried back to the Botanic Garden and our engineer made the installation. The few simple difficulties that arose were soon corrected, and we now have had three years of trouble-free heating that maintains the "cold greenhouse" idea, yet insures against freezing. If others have also discovered this unorthodox new use for domestic water heaters, all to the good. If not, we pass on our experience with enthusiasm.



Buhle photos

Four partially overlapping shelves at left, 18 inches apart and each narrower than the one below it, provide 200 sq. ft. of bench space; bench at right, 100 sq. ft. of space.

Construction

Here are the essentials as they apply to our installation:

Basic greenhouse—faces south, constructed of cement blocks, outside dimensions 35 by 11½ feet. Dirt floor 2 feet below soil level, duckboard walk. Soil level 5 feet high at back wall (north). Unattached to any other building. Water and electric line the only services.

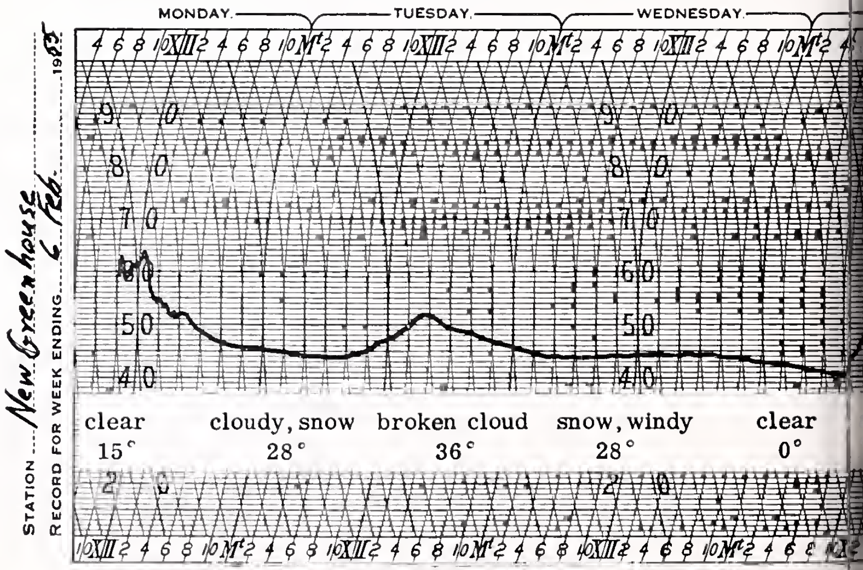
Heating system—82-gallon insulated domestic Hotpoint electric water heater. Other details as for any domestic hot water system, but with simple coil radiation instead of radiators (see diagram of heater installation).

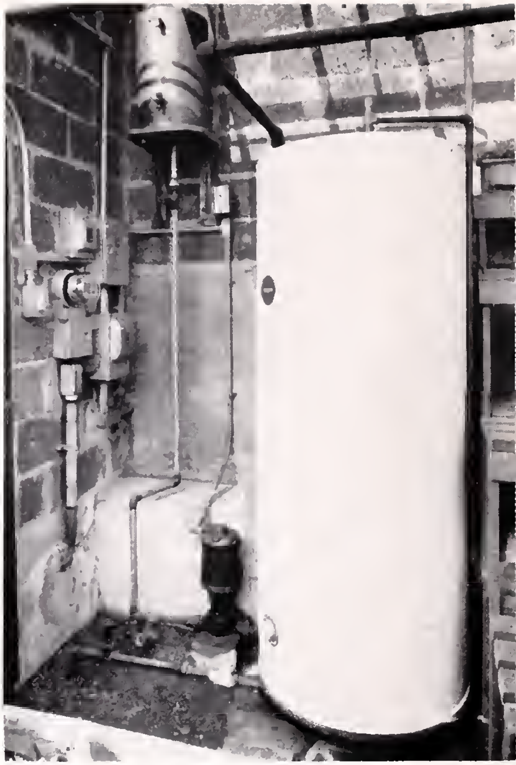
Performance

To test performance, a continuous recording was made of inside temperatures between early January and mid-April, and minimum outdoor temperatures were recorded for each 24-hour period. Observations on cloudiness, snow, and other weather conditions were also made. Here, in brief, is our experience.

Heat from the sun has given surprising greenhouse warmth on clear, cold winter days. But when the weather is cloudy or after the sun has set on clear days, the greenhouse temperature falls rapidly. Typical examples: on sunny days when the outside temperatures range from 22° to 35° F., the greenhouse reaches a sun-heat peak of 75° to over 80° at mid-day, and remains at those temperatures for as much as two or three hours. On such days it remains above 55° for as much as six to eight hours. During the hour which includes sunset, the greenhouse temperature may drop as much as 15 to 20 degrees in a half-hour. The thermostat is generally set between 45° and 55° F., so the hot water starts to circulate when the greenhouse temperature reaches that point. The two 4-kilowatt heating elements in the water heater (total 8 kw.) cannot fully meet the demand on colder nights. On such nights, when the outdoor temperature falls to 0° F. or somewhat below, the greenhouse temperature gradually goes down as low as 40° by 6 to 8 A.M. This leaves a margin of 8° above freezing. On the few nights that have been several degrees below zero, we have always had a good margin above the danger point.

Graph line gives continuously recorded temperature in greenhouse for a typical week in early February. Weather conditions and minimum daily outdoor temperatures (in degrees F.) are noted on chart.





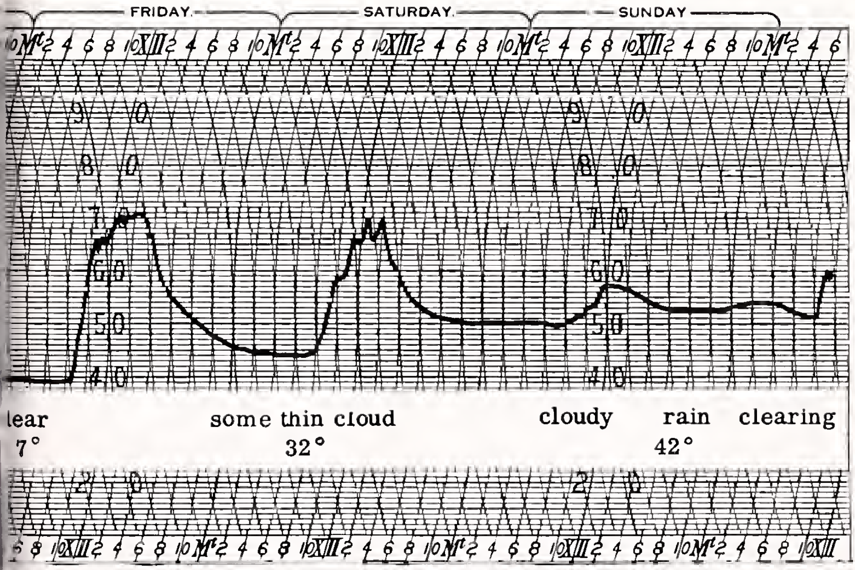
Electrically heated tank, circulating pump, and expansion tank (upper left).

Buhle

In short, the 80 gallons of water at 170° that goes into action soon after sunset on a cold winter evening, plus the electric units in the tank coming into action, are sufficient to keep the greenhouse pleasantly above freezing during the lowest night temperatures we have experienced over the past three years here on western Long Island.

Electric Consumption

Whether protection against greenhouse freezing is economically feasible with electric heating, depends on the power rate. With a greenhouse the size of ours, the highest *weekly* use was approximately 500 kilowatts (mid-January). This tapers off to less than 400 kilowatts per average week in February, and 300 in March. Except for rare instances, heat is not essential in our climate after the first few days in March. With reasonable care, total consumption of electricity from late November through early March can be held to about 5000 kilowatts.



IT'S UP TO PUBLIC TO BAR BILLBOARDS FROM NEW HIGHWAYS

Inez Robb

Reprinted from the *New York World-Telegram and Sun,* September 9, 1957

If a small group of predatory Americans were openly plotting to loot Fort Knox of a billion dollars, this country would be up in arms, demanding that authorities take proper measures to prevent such a colossal theft.

But the carefully plotted theft of billions of dollars in American scenic beauty by the billboard interests has caused scarcely a public ripple since a U. S. Senate committee has killed—at least for effective action at the recent session of Congress—a measure to regulate outdoor advertising on the nation's new 41,000-mile superhighway system.

The skillful and constant lobbying of the rich, powerful and unconscionable billboard industry, which has already done incalculable damage to the American landscape, is clearly reflected in the 7 to 6 vote of the Senate Public Works committee to kill the regulatory measure.

Those opposed to the defacement of America's birthright of beauty may have lost the first round, but they haven't yet lost the fight, if the American public will only get up off its easy chair and start swinging.

Sen. Richard L. Neuberger (D., Oreg.), sponsor of the bill strangled in the Senate committee, assured me before the Senate adjourned that he and Sen. Albert Gore (D., Tenn.) would press for action on the matter in the next session of Congress.

" We have two courses of action," Sen. Neuberger said. "We can ask the Senate committee to revive the bill, hoping that some members of the committee, after going home and sensing the country's indignation, will change their vote in committee.

"Or, when routine and non-controversial bills dealing with interstate highways are introduced in the Senate, we can offer the measure to regulate billboards as an amendment.

"In the latter case, members of the Senate will have to stand up and be counted on the Senate floor. Then, they will probably remember the anti-billboard sentiments of the folks back home.

"We are fighting a rich and powerful lobby. In 1940, billboard advertising racked up $44 million annually; today, it has swelled to $200 million.

"The alarming fact is that time is on the side of the billboard interests. The longer the nation toys with a regulatory measure, the more firmly entrenched the billboard interests are. Seventy-five percent of the new federal interstate highway system will be built over new rights-of-way. The signboard companies are already contracting long term leases—'grandfather rights'—with owners whose property adjoins the new roads.

"It will be far, far harder to get the billboards off the new highways than to keep them off. It will cost the country more and more as time goes on.

"This billboard onslaught on the new highways constitutes an enormous steal, a huge theft from the public, for the fur-

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ther exploitation of a captive audience."

Sen. Neuberger has a proper contempt for the "psychological" experts the billboard interests have hired to propound the phony view that scenery isn't good for people, particularly motorists who, if exposed to the scenic beauty of America, will become hypnotized by such "monotony," wreck their cars and kill themselves.

"If that were true," the senator said, "Hawaii, Alaska and Switzerland, where billboards are forbidden, would be depopulated by now."

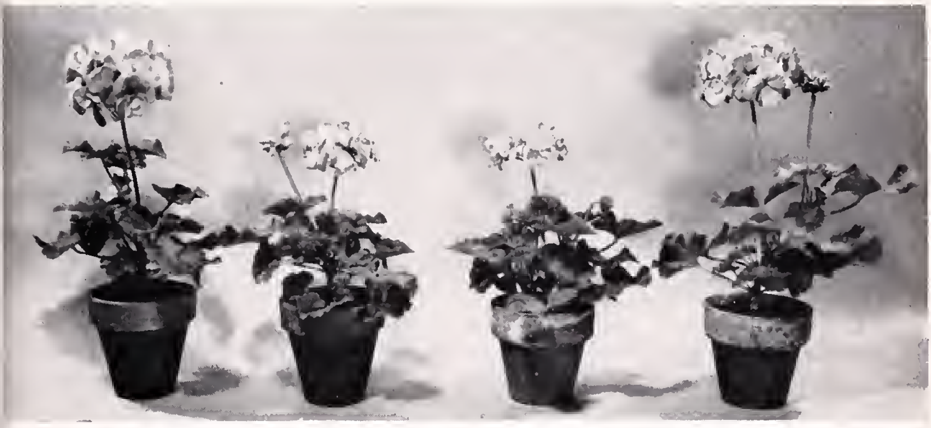
As for you and you and you, if you want to stop this greedy grab, WRITE your Congressmen. You haven't got the money that the billboard lobby has, but you've got pen and ink.

GIBBERELLIN -- EXCITING NEW PLANT GROWTH SUBSTANCE

Report on some of the proven potentialities and limitations of this remarkable new chemical for controlling growth in plants

Peter K. Nelson

DURING the past year a new "wonder drug" called gibberellin has been available to gardeners. This potent chemical influences growth in remarkable ways, and has been the subject of many articles and reports, both scientific and popular. As frequently happens with such products, some advertising claims have been misleading. Gibberellin and its effects upon plant growth are so remarkable that exaggeration is quite unnecessary. For the most part, it actually produces the effects claimed for it. Gardeners may be misled, however, in being made to feel that all the effects are desirable and that more or less blanket applications of gibberellin to plants will "improve" them all. It does not follow that because a



Courtesy Merck and Company

Effect of gibberellin on geraniums. Center plants were untreated. Plants on ends treated 3 weeks before photograph.

coleus plant 1 foot tall is beautiful, one 2 feet tall will have twice the beauty. Nor are large flowers always more attractive than small ones. A florist's hydrangea that had been treated developed a cluster of flowers of unusual size, but it had a loose, floppy appearance that was anything but attractive. Nevertheless, it is safe to say that gibberellin is one of the most important developments in agricultural chemistry that has been made to date.

Discovery

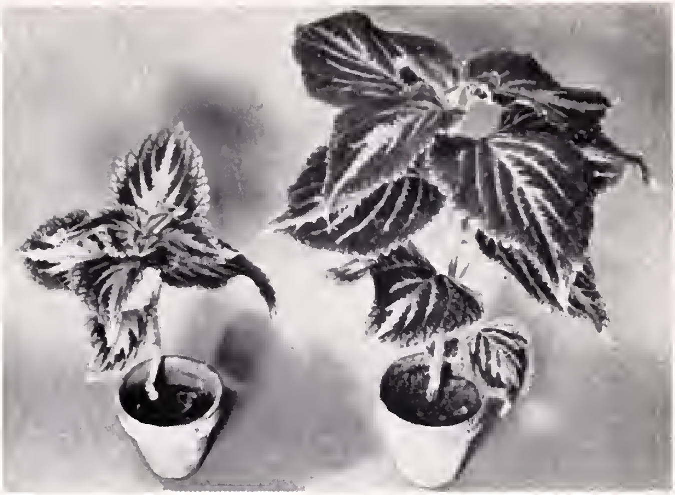
The story of the discovery of gibberellin (actually there are several related chemicals called gibberellins) is now well known. It is sufficient here to recall that its discovery ultimately dates back to studies on a peculiar disease of rice, the Bakanae disease. The infected seedlings grow very rapidly, outstripping their fellows before toppling over. This unseemly behavior accounts for the name, which means "foolish seedling" disease. A scientist in Formosa found that a parasitic fungus, *Gibberella fujikuroi,* was the cause of the disease, and he also found that an extract of the fungus when applied to rice seedlings caused the same sort of rapid growth that was a symptom of the disease itself. A dozen years later the active chemical substance was isolated from the fungus and purified. When this purified chemical was obtained it was found that very small amounts of it would stimulate the growth of many kinds of plants. The first material was named gibberellin A, after the fungus which produces it. Other chemically different gibberellins were found later. All this work was done in the Orient, mostly in Japan. It failed to attract interest in the West until the 1950s. Once gibberellin came to the attention of western scientists, its importance was quickly recognized, and research on its plant growth effects has proceeded at a rapid pace.

Like the earlier plant growth hormones called "auxins," gibberellin is effective in fantastically small amounts, concentrations as low as 1 part in a million (about 1 ounce in nearly 8,000 gallons of water) producing growth effects on certain plants. Also like auxin, gibberellin produces a number of different effects, and just what the results of a treatment will be depends on many things, not the least important of which are the concentration of gibberellin used and the particular plant being treated.

Among the significant results which have been achieved in carefully controlled experiments with gibberellin are many which promise to be of considerable importance to horticulture and agriculture

Substitute for Cold Treatment

As most gardeners who live where there is a definite winter season know, exposure to cold is needed by many plants in order to complete their growth cycle. For example, many biennials will not flower and set seed unless they have experienced a certain period of low temperature; dormant buds of many species of trees and shrubs refuse to open properly, if at all, unless they too have been kept at low temperatures for a certain length of time; and many seeds, bulbs and tubers require similar cold treatment before they will sprout. An interesting property of gibberellin, and one that holds great promise, is its ability to replace, in part or completely, the action of low temperatures on many plants. With gibberellin treatment, such biennials as foxglove, English daisy, stock and pansy have been induced to blossom and set seed the same season they were planted. Ordinarily they are planted one year, wintered over, and then bloom the second year. A number of biennial vegetables, among them cabbage, kale, rutabaga, turnip, carrot, beet and celery, respond in the same way. The advantage to gardeners of this effect of gibberellin on biennials grown for their flowers is obvious: blooms can be obtained the same year the seeds are planted. Flowering and seeding of vegetables are usually not of interest to gardeners, and may even be undesirable. The advantage to the layman in these cases is indirect—it means shortening the time and cost of production of commercial seed and speeds up the pro



Two coleus plants of same age; one on right was treated with gibberellin 2 weeks before being photographed.

duction of improved varieties through hybridization.

Those seeds that respond to gibberellin treatment need no longer be stratified, and seedlings can be obtained from them with less time and trouble than without the treatment. This effect of gibberellin (and its action on some dormant buds) means that certain plants, for instance peaches, can be grown in warmer climates than has been possible up to now. Treating some seeds, among them beans and peas, has resulted in better germination in a shorter time, and in more rapidly growing seedlings.

Effect on Long-Day Plants

Some plants will not bloom unless they receive a certain long period of daylight. They are called long-day plants and include many common vegetables and flowering plants. It has been found that gibberellin will stimulate many of these long-day plants to bloom, even though the period of daylight they receive is too short to induce blooming. Lettuce, endive, radish, spinach, mustard, Chinese cabbage, dill, petunia, stock and pansy are known to show this response to gibberellin. Even when conditions are favorable for normal flower production, it can be speeded up from 10 days to 4 weeks in stock, petunia, larkspur, English daisy, China aster and others. Ten to 100 parts per million of the chemical were sufficient to do this without making the stems become too long. Higher concentrations of gibberellin caused long, weak stems.

Lawns Grow Earlier

A very interesting effect of gibberellin on lawn grasses has been reported. Concentrations as low as 1 ounce per acre have been found to stimulate growth in early spring at temperatures considerably below those ordinarily required for growth to begin. Thus it is possible to have a green lawn appreciably earlier than usual. Grass stimulated in this way becomes pale in color unless it is given extra fertilizer. When this is done it maintains a rich green color. Some gibberellin-treated crops, especially some forage crops, show a marked increase in the weight of the harvest. To realize this gain to the fullest, additional fertilization is likewise necessary.

It is still much too early for any full evaluation but judging from the results so far obtained with gibberellin, it seems that the greatest benefits to lay gardeners will come from its use at the commercial horticultural and agricultural level. Still, many gardeners will find it enlightening and stimulating to carry out novel growth experiments to see for themselves what gibbberellin can do.

The Golden Age gardeners check the progress of their cuttings to see how well roots are forming.

GOLDEN AGE GARDENERS

Never too old to learn

Lewis F. Lipp

Condensed from *Horticulture*, May, 1957
(With supplementary photos courtesy Holden Arboretum)

SENIOR citizens who reside in Cleveland's Golden Age Center, are helping to develop a great arboretum in the nearby community of Mentor. "Never too old to learn" is the maxim of this unique group of "golden age" gardeners who travel by station wagon each week to the Holden Arboretum, located in the heart of Ohio's expanding acres of commercial nurseries. This extensive arboretum, established only 16 years ago, comprises more than 1,000 acres.

All types of ornamental flowering shrubs, trees, evergreens and ground covers, hardy in the region, are being planted. The aim is to make available to home owners and amateur gardeners as complete a collection of plants as possible to aid them in planning and planting better gardens. Interested persons are invited to become members of the Arboretum and to participate actively in its growth and development.

It was the wife of Warren H. Corning, one of Cleveland's leading citizens, who nurtured the idea of providing a new outlet and an exciting hobby for the golden age group. Garden club members serve as instructors and share their horticultural knowledge in carrying out the proj-

Published at Horticultural Hall, Boston 15, Mass.

Sorting wooden labels prior to attaching them to trees in Holden Arboretum.

Labeling rare weeping golden-chain trees (*Laburnum alpinum pendulum*) from British Columbia.

Matjasic photos

Matjasic

Mrs. Warren Corning, originator of the golden age gardeners plan, and two of the gardeners examine plant in Holden Arboretum's greenhouses.

ect. Upon arrival at the greenhouses the women don colorful aprons and spend the first 15 minutes of each session receiving instructions and asking questions about the specific tasks which they are to carry out.

Practical lessons in the various phases of horticulture are carefully planned. These include methods of plant propagation, such as stratifying seed, transplanting seedlings into flats and making softwood cuttings. How to hybridize azaleas and rhododendrons gives these enthusiastic gardeners an introduction to the art of plant breeding. A series of demonstrations in the various types of grafting and layering is also included.

On pleasant days, the class makes walking trips through the arboretum to learn first hand about the great collection of plants assembled there. Since they help to make labels for the plants, each and every student learns to understand the how and why of an arboretum.

The making and rooting of cuttings is perhaps one of the most appealing phases of gardening to this group, especially when they learn that they are working with some plants which are considered difficult to root. Enthusiasm runs high when one of the group can proudly display well-rooted cuttings of a rare maple or some other unusual plant with which she has succeeded. This kind of personal satisfaction in accomplishment adds zest and stimulus to the class and gives the members something to look forward to at each meeting.

Enrollment in the golden age program is purely voluntary. The only requirements are that the individual has reached the age of 65 and has a desire to participate in the program.

Both the "golden agers" and the garden club instructors have found this program stimulating and inspiring—a source of new confidence to face the years ahead with optimism and courage. It is the intention of the Holden Arboretum to continue to conduct these groups and eventually to provide similar opportunities for other groups such as crippled children, disabled veterans and the blind.

THE DYING OAKS

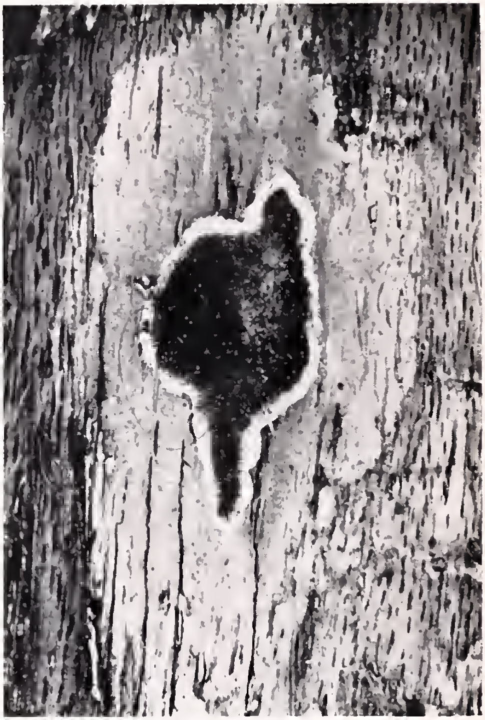
During the past 30 years a deadly fungus disease has been steadily spreading through the U. S. oak population. Fortunately the disease can be controlled, but to control it will require strong measures

George S. Avery, Jr.

Condensed from *Scientific American*, May, 1957

OVER a wide area of the U. S. the mighty oak is in distress. The nation's best-loved tree is threatened by a creeping disease which already has taken hold in most of the Midwestern states. The disease is so leisurely and undramatic that for many years it went unnoticed. Death steals over the tree unobtrusively: its high crown begins to wilt and turn brown; the leaves gradually fall; eventually the tree stands bare and lifeless. At least 30 years ago occasional oaks began to sicken and die in this way in woodlands of Iowa, Minnesota and Wisconsin. But the disease was not definitely recognized until 1942. By then it had begun to expand alarmingly. The "oak wilt" disease has now spread to thousands of oak stands in 18 states, from Nebraska in the west to Pennsylvania in the east. To many people it is ominously reminiscent of the blight that wiped out the American chestnut a generation ago. Fortunately oak wilt seems more likely to be brought under control.

The oak blight is incomparably more dangerous than Dutch elm disease. The elm gives us lumber chiefly for furniture, but is hardly of the importance of the oak, one of our great natural resources. It accounts for nearly one tenth of our total lumber production, and the current value of the oaks in our commercial timberlands is estimated to be more than $2 billion. For flooring alone we used last year a billion and a half board feet of oak, worth more than $200 million. This is ten times the consumption of elm. Oak is probably our most widely useful hardwood; and the value of the oak as a noble ornamental and shade tree in the American scene is beyond all estimate.



Fungus of the oak wilt disease grows in a mat beneath the bark of an oak. The bark, which here has been removed to expose the mat of fungus, is cracked open by its growth.

The alarmed lumber industry, the U. S. Department of Agriculture, the several states affected, agricultural experiment stations and universities have joined forces with the National Oak Wilt Research Committee, and during the last

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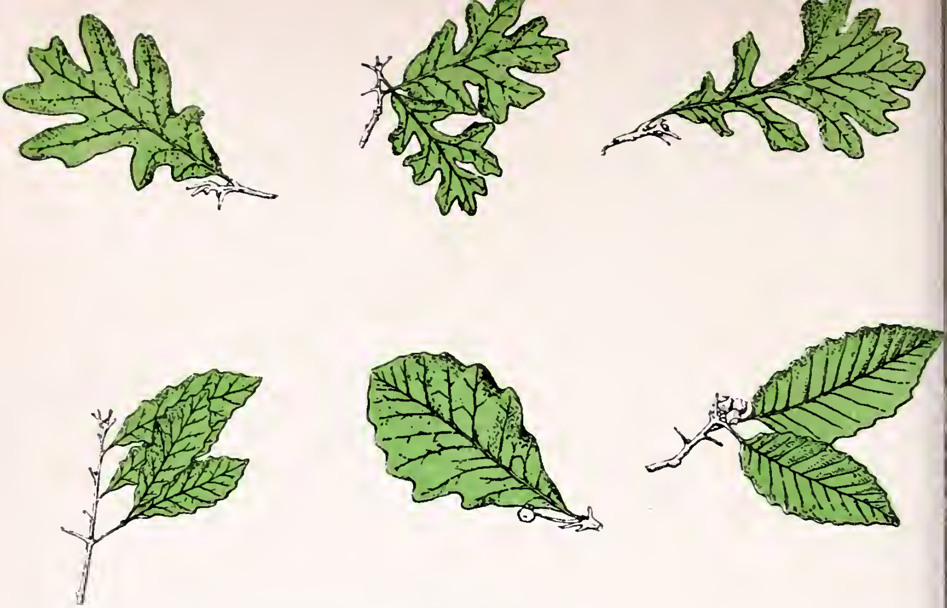


These are leaves of six members of the white oak group: white oak (top left), post oak (top center), burr oak (top right), chinquapin oak (bottom left), swamp white oak (bottom center) and chestnut oak (bottom right).

few years many hundreds of thousands of dollars have been provided for studying and fighting the disease. Much has been learned about its cause and possible ways of combating the infection.

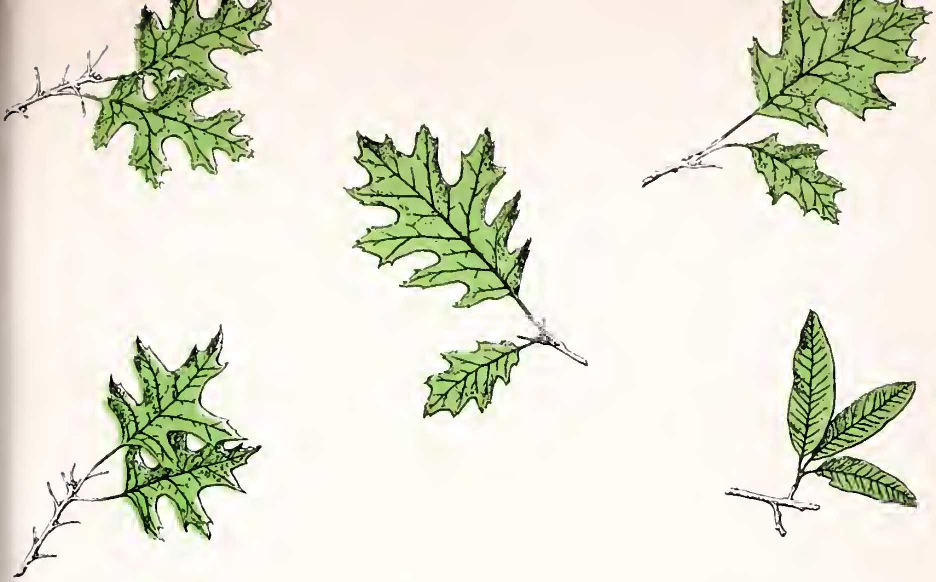
Like the chestnut blight and the Dutch elm disease, oak wilt is caused by a fungus. The particular fungus responsible for the attack on the oaks has been rather difficult to classify. It is currently called *Ceratocystis fagacearum;* the species name indicates its partiality for the *Fagaceae* family, which includes oaks, chestnuts and beeches. This fungus can grow in the ash, hickory, dogwood, wild cherry and other trees as hosts, but up to now it has been found to produce wilting symptoms only in the oak, certain chestnuts and the apple tree. The fungus can reproduce itself by either sexual or asexual spores. It is a hermaphrodite (*i.e.,* capable of acting as either male or female), and individual fungi can cross-fertilize one another.

The organism gets into a tree through the roots or through wounds in the trunk or branches. It spreads through the tree's system by way of the sapwood under the bark. The strands of the growing fungus and a gummy secretion clog the tree's water-conducting vessels, and this is evidently responsible for the wilting of the leaves. Leaves at the top of the tree and the ends of branches begin to wilt and turn yellow or bronze. Gradually they die and fall. The early stages of the disease usually go undetected from the ground, because the wilting crown is concealed from view by the green foliage of the lower part of the tree.

Every species of oak so far tested is susceptible to the infection. Trees of the red oak group (red, black, scarlet, shingle, chestnut and pin oaks) commonly lose all their leaves and die within a single season; red oaks may be killed in a few weeks. Even the biggest and most vigorous specimens succumb. The disease kills the tree down to its roots, so that the stump does not sprout new shoots later, as blighted chestnuts are apt to do.

The white oak group (white, post, burr, swamp white and chinquapin) resist the disease longer than the red, but within five years they too generally die. Their branches expire one by one, and the dead, defoliated upper branches may stand out from the green body of the tree like the antlers of a giant stag.

How does the disease spread? One way is underground, through the roots from tree to tree. In a stand of oaks growing



Five members of the red oak group: scarlet (top left), black (top right), red (center), pin (bottom left) and shingle oak (bottom right). Oak wilt disease may kill red oaks in a few weeks. White oaks may survive for five years.

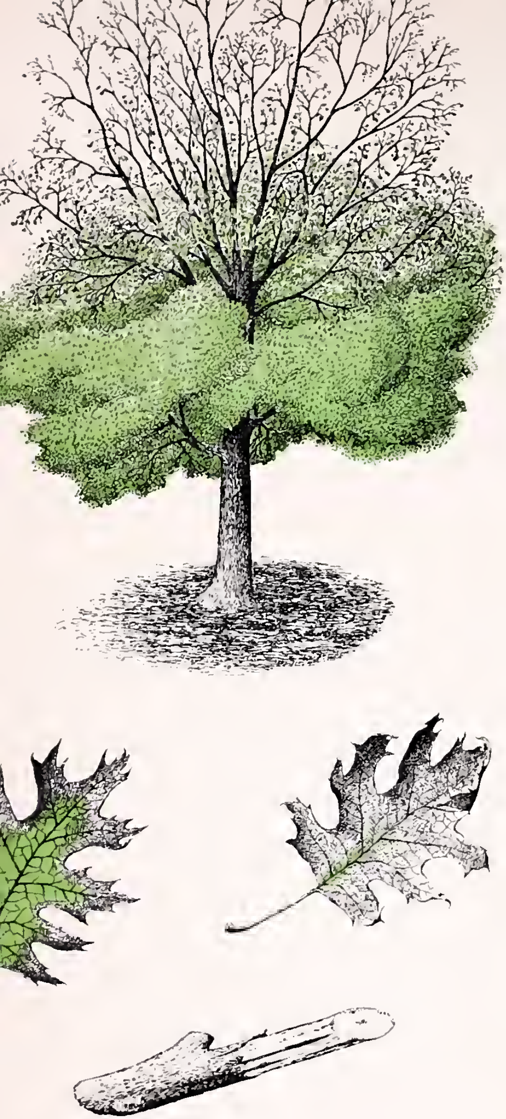
close together, the roots of neighboring trees become grafted to one another. The fungus can grow through the joined roots and the infection spreads out to widening circles from a center of infection.

But the disease also jumps overland for considerable distances. Presumably insects are the chief carriers in this transmission. Several species of insect, notably certain beetles and fruit flies, are attracted to the mats of fungus spores in diseased trees, and these insects have been found to carry the fungus internally and externally. The mats of spores grow under the bark of killed trees, mainly in the fall or spring. A single dead tree may have as many as 200 such mats, some of them as big as a man's hand. The growth of mats cracks open the bark. The beetles, attracted by the fruity odor, invade the cracks and feed on the mats. Squirrels also eat the mats; they may well carry the disease from one tree to another, and it is possible that birds also are carriers.

The dangerous season for spread of the disease is late spring and early summer. The sapwood is then forming, and climatic conditions are ideal for the fungus and the beetles that spread it. Tracer studies with radioactive iodine have shown that the beetles begin to be active in spreading the spores when the seasonal temperature rises to 70 degrees; the fungus itself grows best at temperatures between 65 and 75 degrees. (It does not live long in hot weather, so there is hope that oak wilt disease will not spread in the South below Arkansas and Tennessee.)

A tree with its bark intact is protected from insect carriers; it is the trees with bleeding wounds that become infected. The insects gain entry into trees which have been pruned, torn by lightning, broken by storms, cut or blazed by lumbermen or otherwise laid open. Therefore, one thing that can be done is to avoid injuring or cutting oak trees in the spring. Apparently they can be cut or pruned safely later in the summer, for trees wounded at that time have not shown evidence of infection.

Nevertheless the slowness of its spread has given time to take counter-measures, and the disease is being fought with a number of different methods. The first need is to spot the centers of infection at an early stage. This is difficult from the ground, so surveys are made by airplane to detect the browning tree crowns. Where the disease is spreading underground via the roots, steps have been



Symptoms of the disease in the red oak are depicted above. The leaves at the top of the tree turn yellow or bronze and litter the ground (top). The green of the leaf fades (shown in two stages in middle). When a twig of the tree is cut and peeled, there are discolored areas just beneath its bark and dark areas in its cross section (bottom).

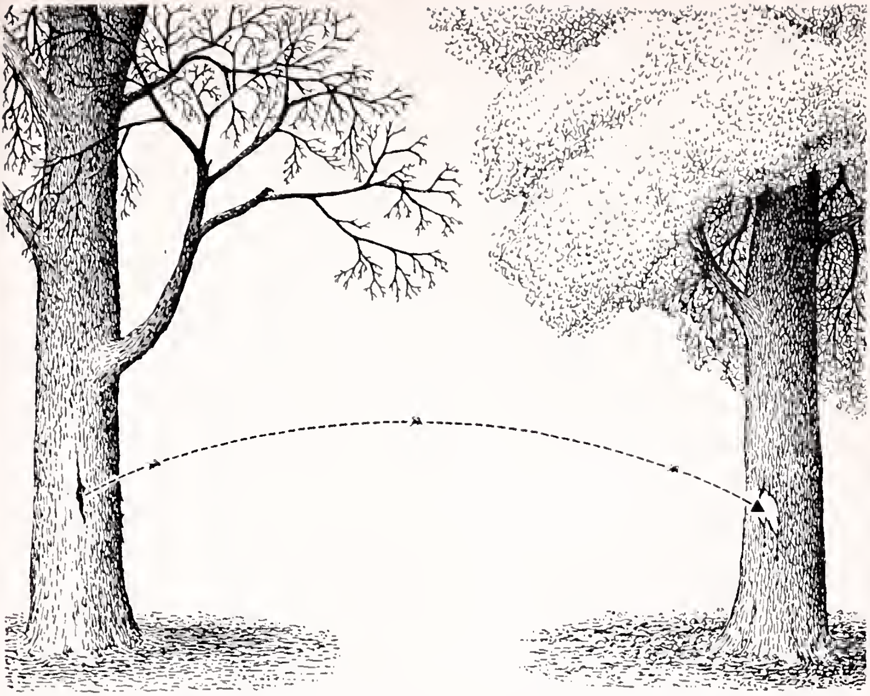
taken to isolate the infection center, in some cases by cutting the roots in a circle around it with trenching machines, in others by poisoning the trees surrounding the center. The roots of infected trees must be killed, because the fungus can live on in them for at least three years. The bark, branches and twigs of killed trees should be burned immediately, but their useful lumber can be saved. If it is sawed up and kept off the ground, the fungus disappears in a matter of weeks as the wood dries. No infection can spread from the dried oak wood, and the wood is not damaged by the wilt disease.

For checking the overland spread of the disease, the simplest method tried so far is to girdle infected trees, cutting deep into the heartwood. This is fairly effective in preventing formation of the spore mats on which carrier insects feed.

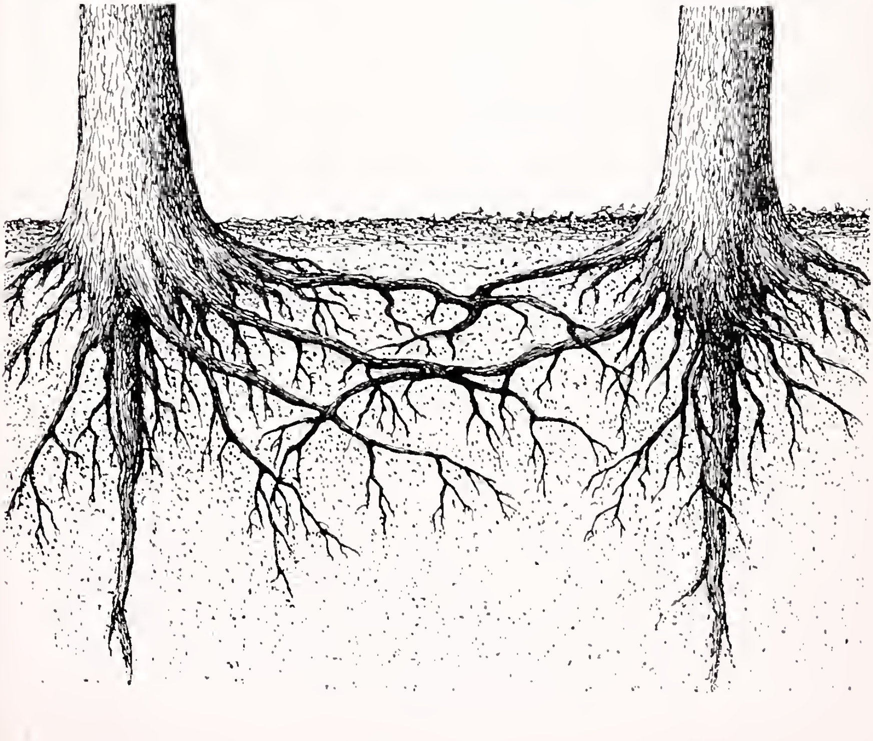
Certain antibiotics have shown some effectiveness against the oak wilt fungus in experiments. But such treatment is expensive, and at present impracticable on any large scale, although we may be on the threshold of a major advance in attacking tree diseases with antibiotics.

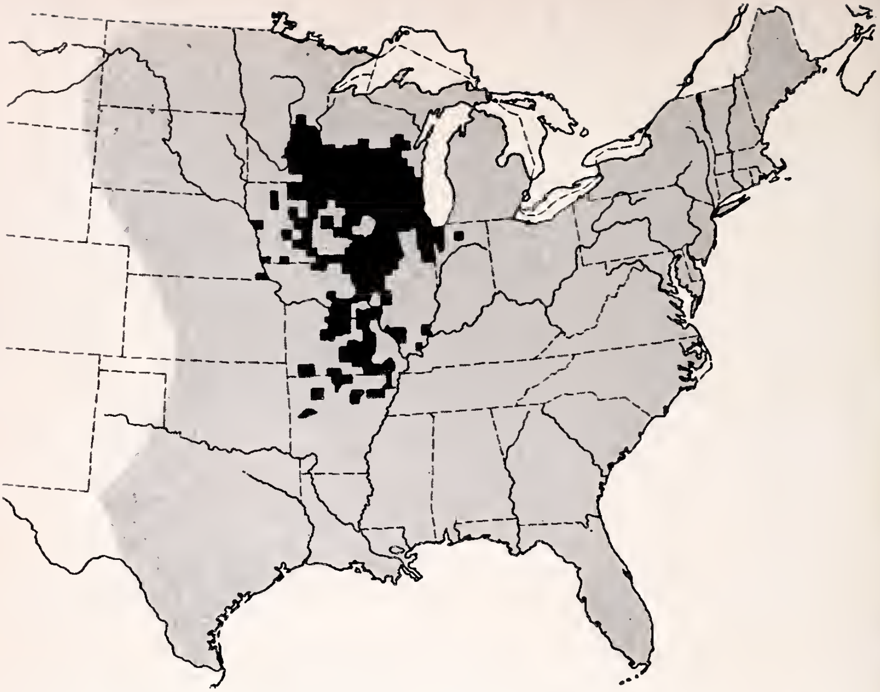
Epidemics in the plant world are a totally different problem from those in the human population. As the oak wilt makes so clear, thousands of trees over thousands of square miles may have a disease for years before anyone is seriously aware of it. When the epidemic is discovered, treatment has to be carried to the trees: a sick tree cannot come to the doctor's office. A plant does not develop immunity against infection, nor can it be given artificial immunity by vaccination or inoculation. And no one would propose spending as much money to save trees as to save human lives. Given a virulent and widely distributed plague in the tree world, the odds for successful control are little better than for the human plagues that swept Europe before the era of modern medicine.

Nevertheless, plant pathologists do not expect the oaks of the U. S. to meet the fate of the chestnut. With sanitation methods (*e.g.*, burning diseased trees), and with cooperation from timbermen and home owners, they believe oak wilt can be brought under control. (The National Oak Wilt Research Committee

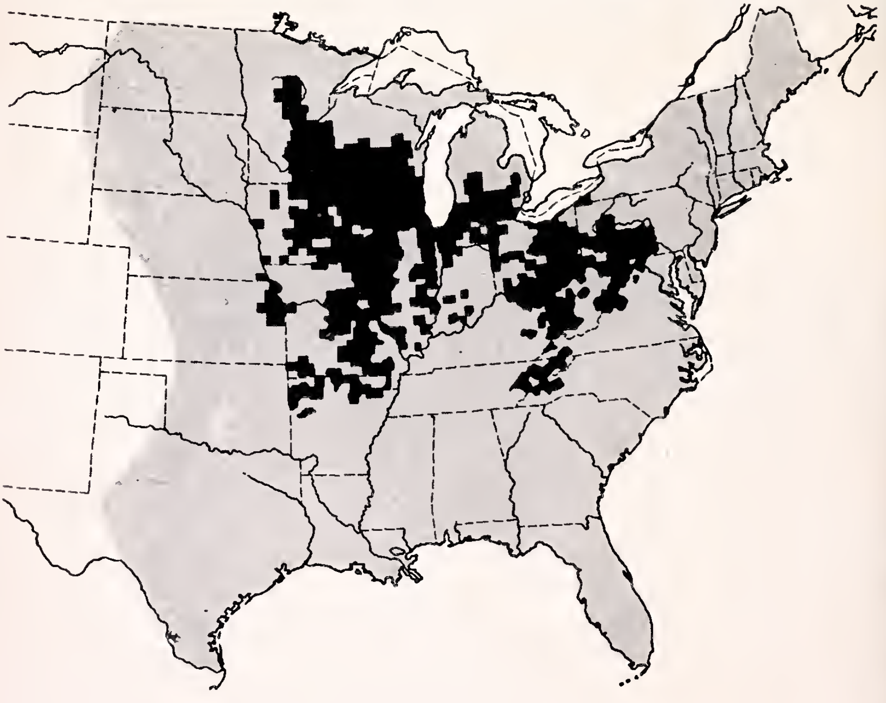


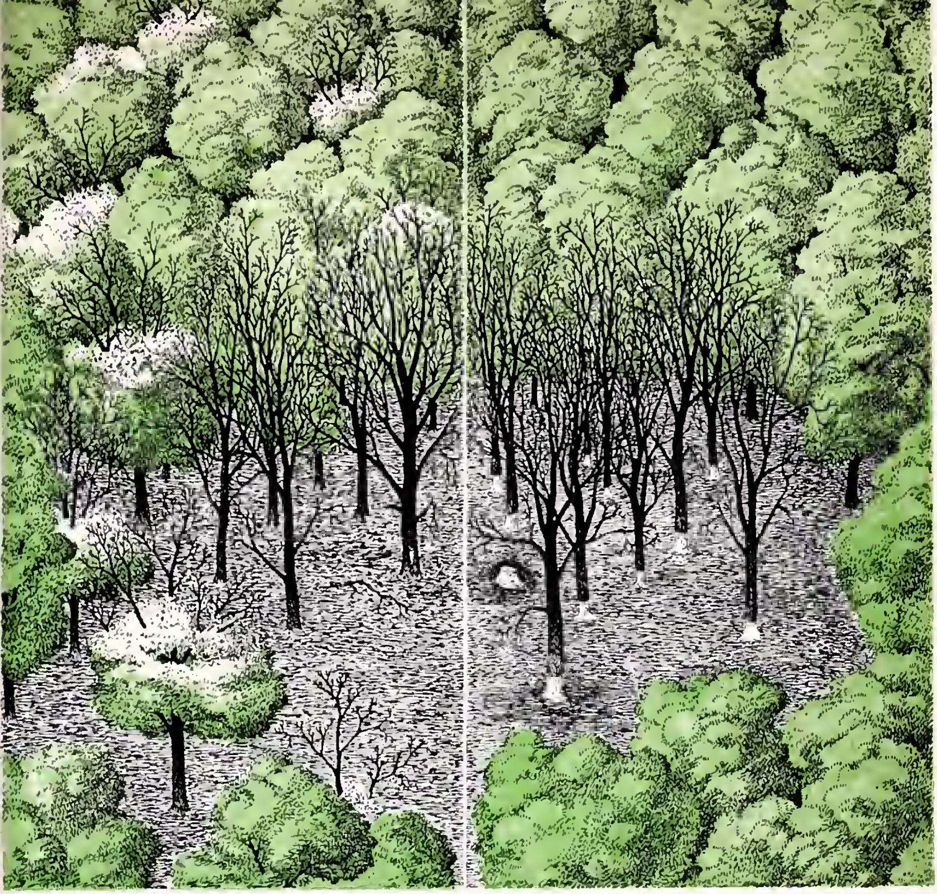
Disease is spread by contact under the ground or at a distance by air. An insect may feed on a mat of fungus in a diseased tree; if the insect then feeds on sap oozing from a spring wound in a healthy tree, it may transmit the spores of the fungus (top). The fungus can also be transmitted by way of roots that have become grafted together (bottom).





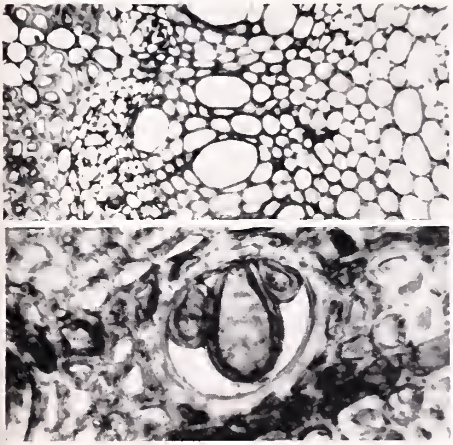
Counties reporting the disease in 1950 are shown in black at the top; counties reporting the disease in 1954, at bottom. Oaks subject to the disease grow in the gray area.





Prevention of the spread of the disease is illustrated by this drawing. At left is a section of forest with a cluster of dead trees which had become infected with the disease in the preceding year. The disease has now spread to nearby trees. At right is a section of forest in which the diseased trees had been deeply girdled in the preceding year, while their leaves were still in the wilting stage. This has killed the trees but prevented the formation of fungus mats and controlled the aerial spread of the disease.

urges that suspected trees be reported promptly to state experiment stations.) Most pathologists doubt that the disease can be eradicated, but they are inclined to be confident that it can be reduced from a menace to a nuisance. However, active and widespread measures must be taken if we are not to lose most of our oak trees during the coming century.



Stalk of a healthy leaf of the pin oak is shown in cross section in the photomicrograph at top. At bottom a water-conducting cell in the stalk of a wilted leaf is obstructed. The photomicrographs are by B. Esther Struckmeyer of the University of Wisconsin.

SHORT COURSE IN POISON IVY

Theodore A. Weston

Reprinted from *American Home,* June, 1957

UNLESS you *know* you're immune to ivy poisoning—and few people are—be everlastingly *scared* of the plant that causes it. The mildest case is no joke, and a serious case is dangerous. So: 1) *learn to recognize* poison ivy anywhere; 2) *eradicate* it from your property.

To recognize it, remember that it's a *vine,* either climbing or ground-covering, and that the leaves are made up of *three* leaflets. Young leaves, when opening out in early spring, are reddish and decidedly glossy. Mature leaves are rich green, fairly glossy. In fall, the leaves turn red again.

If you touch it, rub the place *immediately* with dry soil, sand or absorbent cloth; then wash with yellow laundry soap. If a rash develops, and you suspect ivy poisoning, see your doctor!

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You can pull out *young* plants—but be *very* careful. Use newspaper, as here, or thick rubber gloves. And don't let your clothes or shoes touch the ivy!

Don't ever cultivate, dig or plant, barehanded, in any area where poison ivy leaves, stems or roots may be in the soil.

You can destroy poison ivy in wild areas by soaking the ground with a general weed-killer that contains an herbicide like ammate or borax.

→

But don't use a soil-poisoning herbicide on your garden beds. Choose a poison-ivy or brush killer that contains amizol or 2,4,5-T, and apply it with a sprayer. Chemical is absorbed by leaves, so protect nearby plants from spray with newspapers.

←

Always discard unused weed-killer—where it can't injure anything—and wash out sprayer or watering can with a kitchen detergent and then three or four fillings of plain water.

Three Lions photos

Don't touch clothing or shoes that have been in contact with poison ivy. Wearing rubber gloves, wash clothing with plenty of soap or detergent, and rub shoes thoroughly with soapy rag.

Don't pet your dog after he has romped in poison ivy. He is immune, but the poisonous oil clings to his fur. Wear rubber gloves, rub him with cotton rag, then bathe him.

Don't ever touch raked-up garden rubbish if there's any chance that it includes any poison ivy. Carry it with a rake or fork.

Don't burn it! The poison is carried by smoke in tiny droplets. Use herbicide on pulled-out ivy and bury or pile somewhere to decompose.

In case your're concerned, this young man who posed for the photos at the Brooklyn Botanic Garden is apparently immune to ivy poison. Immunity, however, seems to be a relative matter and can change with a person's physical condition, age, and other factors. To be on the safe side even ''immune'' persons should avoid any unnecessary contact with poison ivy.

Three Lions photos at Brooklyn Botanic Garden

CONSERVING OUR NATURAL HISTORY HERITAGE

Richard H. Pough

Reprinted from the *Bulletin of the Garden Club of America*, November, 1957

MANY conservation projects have been made possible only through the work of thousands of interested individuals, and foremost among them have been the garden clubs. Conservation covers many different topics. All of us are concerned with the resources needed for our economy. Business interests today realize that the future of industrial activity depends on availability of water, and large sums are being made available for water conservation on a hardheaded basis. But when we need to preserve things because of their aesthetic or scientific value, where there is no economic gain involved, we must fall back on civic groups.

The remnants of wild nature disappear very rapidly and no new ones are being created. We have reached a point, with our swelling population, our ability to exploit land, where the last remnants of many interesting assemblages of plants and animals, the things we call wildlife communities, are disappearing. There is no possibility of restoring them, once eliminated.

So our generation has a very important job, for these areas will not outlive us. Many persons say "That marsh or that patch of woods has always been there." They don't realize that unless we now place some protection over those remnants of original vegetation and wildlife they will not continue to exist. Somebody will find it profitable to go in and fill or drain or flood, or do something in order to make money. We are in a last ditch fight to preserve, in many sections, remnants of plant and animal communities that clothed the country before the white man came.

These areas represent the end product of two billion years of evolution, during which living things were evolving from simpler forms and adapting themselves to different types of environment as they occurred. We know life started with simple forms and became increasingly complex as organisms evolved. There is hardly a place on the globe that hasn't a collection of plants and animals that we speak of as wildlife or biological communities. They are the end product of this long period of development.

I think we have an obligation to pass them on to coming generations not only as living museums of nature but as storehouses in which we keep going the organisms that have taken so long to develop. Who is to say that they have no value? A few years ago who would have said that we would be getting substances from soil molds that would cure diseases? Today we have seen enough revolutionary development in the biological field to make us realize that every single organism has potential value for man.

Urban and Suburban Problems

We also need to preserve open space. We have the whole problem of what sort of community we are creating for the coming generation. More and more the great problem that looms is mental health. The answer is to preserve environment and living conditions to make life happier for people, but we are not doing that. We did a better job 50 or 60 years ago when we set aside parks in our big cities. In the suburbs growing up around the cities we have areas like the Morton Arboretum; or the Mianus Gorge near New York, but

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they are all too rare. Developers are moving into communities and buying every acre of land. Just because each house has a half acre or an acre lot, they seem to feel they don't need parks. Then you find that when the kids want to go on a hike or their fathers want to go looking for birds, or just for a walk, they go into the little patches of woods that are left. They are still privately owned. The assumption is they will remain that way. They will not. So it is important, in the interest of keeping our communities from becoming suburban slums, where there is no open area, to acquire units of wild land and leave it to nature.

Our population has reached the point where there are no frontiers, where land is running out. There are more and more people, they want land, and there is no more land. We are setting the land use patterns with which coming generations will have to live. It would be easier for them to alter our government, our economic system, than to alter the patterns of use that we are fixing on the land, particularly in this matter of open space, fresh air, green areas and so forth.

Zoning can change an area from residential to industrial use but it can't turn it back to wild woodland. In many areas land is already terribly expensive. We acquired Island Beach, a strip of New Jersey seashore, and the state paid 2¾ million dollars. Some years ago they had the opportunity to purchase a similar piece for $100,000 and turned it down on the ground there was a lot of undeveloped seashore, so why worry.

In seeking funds we are in competition with more emotionally appealing causes, philanthropies directed at relieving human misery. We need people with the imagination to look ahead, who can afford to contribute to the preservation of these living museums of natural history. Once purchased, the only cost is that of policing; nature will attend to the maintenance, as she has been doing for millions of years.

Preserving Lowland Areas

We are directing our attention in many sections mainly to wet or rocky lands. The wet lands make excellent wildlife refuges. They are relatively cheap and in many cases are an important part of the water management program. Accessibility can be provided by boardwalks and the general wetness often prevents vandalism. We have been able to acquire about 1700 acres of fresh water lowland within sight of the Empire State Building in New York at an average price of $40 an acre, while upland is selling in the thousands. When the upland is used up, the pressure comes on the lowland and the price jumps. It is filled in and its character changed. But there is still time in most communities to preserve some of these wet areas. They are essential to the preservation of water fowl, but we are decreasing the environment available to birds of that type. In terms of wildlife conservation, the problem is one of preserving *environment*. Our laws adequately protect wildlife, the seasons are controlled so the hunted species are not overshot, but all wildlife is threatened unless their environments are preserved. When you preserve the homes of birds you preserve also those of mammals, wild flowers, trees; you preserve them all in one package. Take the list of birds in any region and it will be found that unless their particular types of environment, wet woodland, marshes or whatever, are preserved the variety and richness of local birdlife will decline until there are nothing but robins and wrens, the ones that can live around our homes.

Effects of Modern Agricultural Practice

Unfortunately, the increased use of insecticides is making the maintenance of the bird population very difficult. The problem is not confined to preserving areas where urbanization is taking place; throughout the countryside we need to preserve tracts of land to be kept in grass or allowed to go back into woodland. Intensive agricultural use of land

Two young visitors enjoy learning the names of plants they ''see'' with their finger tips.

Mamay

managed forests are unfortunately not the wildlife havens that the old-fashioned forests were with their dead trees and so forth.

Bogs

Bogs all over the world are being studied to reconstruct the picture of climatic changes. Near Chicago there are two where students are taken from the universities to see plants that are not found anywhere else. They are presumably areas where a great chunk of ice was buried during the Glacial Period. As the ice melted a hole was created. That hole was occupied by a pond or small lake and gradually filled with organic matter and became a bog. In it we find the climatic history of the region. Pollens from trees in the vicinity of that pond blew in each year, settled to the bottom, were trapped in the muck. By taking a profile down through it we can reconstruct the vegetation from the time the glacier disappeared

For a long time botanists have wanted to preserve these two areas. Now, thanks to the initiative of one Chicagoan, options have been obtained on both. The Nature Conservancy has taken the options and agreed to hold the title, but of course it must look to some local group to take care of them and to dig up the funds to buy them from their owners. That is the typical pattern.

What Can Be Done

I would hope that every garden club could have some project of this sort, some area that is particularly interesting to naturalists, that is not protected but should be. Start slowly, get an option on a few acres, see what you can do to raise funds. Gradually develop it and maybe a little nature center could be set up. The important thing right now is to act, to get the land before somebody else gets it and destroys it.

Mamay

The tinkling fountain and pool are another source of enjoyment in the fragrance garden.

where they could be easily touched, smelled or tasted was as important in a garden

Lobularia maritima—sweet alyssum
Nicotiana affinis (hybrids)—flowering to-

George E. Keane

Reprinted from *Flower Grower*, July, 1957
With supplementary photos

WHEN the Fragrance Garden for the Blind was first proposed by the Women's Auxiliary of the Brooklyn Botanic Garden, New York City, it seemed impractical because blind people would have difficulty in reaching it. However, we realized that such a garden would give much pleasure and inspiration to those who could be taken to it, and the "practical" consideration was happily discarded.

Today, thanks to the Fragrance Garden, many of us are finding that gardening can be an absorbing hobby. Since my introduction at the Fragrance Garden to plants that I thought didn't exist except in the pages of Elizabethan literature—*Rosa eglanteria*, columbine, rose or peppermint geranium, thyme, basil and other herbs—I have been seeking them to grow and enjoy in my own home garden. The Fragrance Garden has aroused my interest to such an extent that I have discovered there are fragrant varieties of azaleas and that some species and varieties of roses are more fragrant than others.

Besides providing an opportunity to know plants, sharing the Fragrance Garden with those who see is another of its delights. On my last visit, my wife, daughter and several friends accompanied me. I think my enjoyment was as inspired by their pleasure as by the garden itself. I have been interested to hear gardeners say that having the plants at a level

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Group of visitors leaves the terrace classroom to examine plants in the garden's raised beds.

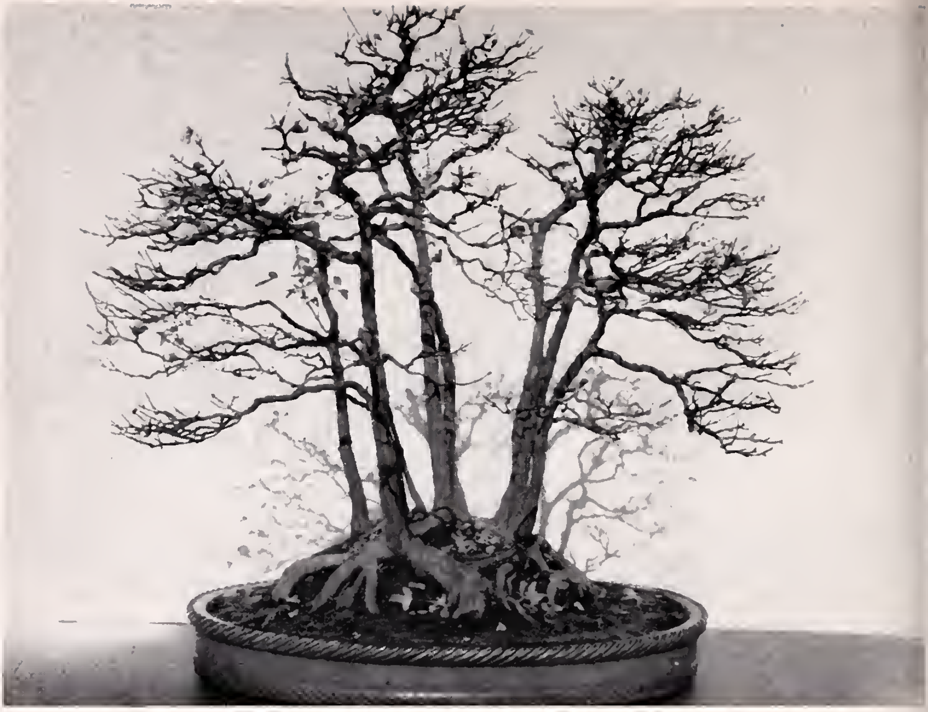
Echeveria peacocki
Echeveria imbricata
Hosta plantaginea—fragrant plantain-lily
Origanum dictamnus—Crete dittany
Sedum sarmentosum
Sedum spectabile
Sedum sediforme
Stachys lanata—lambs-ears
Thymus serpyllum albus—white mother-of-thyme
Thymus serpyllum vulgaris—lemon thyme
Thymus serpyllum Border Gem
Tunica saxifraga
Ulex europaeus—gorse

Plants with texture and fragrance

Artemisia abrotanum
Chrysanthemum balsamita—costmary
Dianthus gratianopolitanus—cheddar pink
Dianthus plumarius—cottage pink
Lantana camara—common lantana
Lavandula officinalis—English lavender
Pelargonium—oak-leaved rose, peppermint geranium
Rosmarinus officinalis—rosemary

Mamay photos

Most of the plants are in waist-high beds for easy access.



Buhle photo

Trident maple (*Acer buergerianum*) trained as miniature forest.

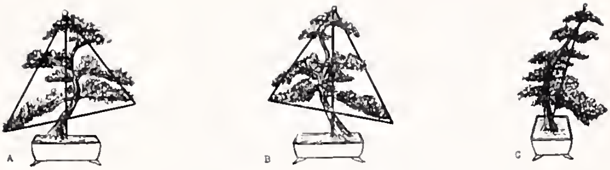
MINIATURE TREES

Yuji Yoshimura and Giovanna H. Halford

(Photographs, Brooklyn Botanic Garden Bonsai Collection)

THE art of growing and caring for miniature trees is one which may be enjoyed practically anywhere in the world, although it has reached its apex in Japan. Owning a particularly fine *bonsai*, as the Japanese call these trees—the word is written with characters meaning "tray" or "pot" and "to plant"—is a responsibility, not to be undertaken lightly. A Japanese who owns bonsai has nearly always taken the trouble to turn himself into an expert; he has studied the art and is probably acquiring a collection of these little masterpieces. He gives up a good deal of his time to their care, belongs perhaps to a bonsai society, allows his best trees to appear in exhibitions, and attends the annual auctions, sometimes to buy, sometimes to sell, sometimes just to "study form." He may well have inherited his most valuable trees from his father and grandfather, for bonsai lovers, like bonsai growers, are both born and made, artists and craftsmen with a long tradition behind them. The all-too-common practice among Western visitors to Japan of buying a bonsai and then allowing it to die through neglect or ignorance

Excerpts from *The Japanese Art of Miniature Trees and Landscapes.* Published by Charles E. Tuttle Company, Rutland, Vt. Copyright, 1957. See page 294.



Redrawn from the "Japanese Art of Miniature Trees and Landscapes"

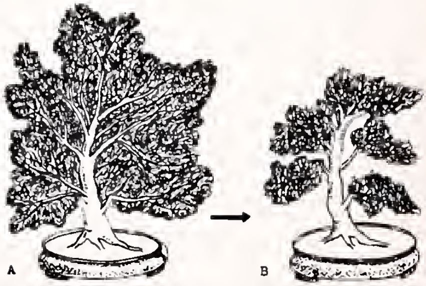
Informal upright style of bonsai. Note how the top point slants to the front. A) Front view. B) Back view. C) Side view.

is shocking to the Japanese. They know that the dead tree, flung on the rubbish heap with a rueful "Oh well, it wasn't so very expensive anyway," represents many years of loving care by some unknown gardener, whose grandfather may have sown the seed.

But the amateur should not be discouraged by this talk of many years and heavy responsibilities involved in making and caring for a perfect specimen. Perfection is rare, and enjoyment does not depend on it; and, as will be pointed out, there are short cuts and "tricks of the trade" by which a handsome bonsai can be created in months rather than years. It is certainly not difficult to learn at least the basic rules which will keep a bonsai alive. With a little trouble anyone who loves plants can give it proper attention, water it sufficiently, keep it free from disease, do simple pruning, and even change the soil when necessary. The smallness of the bonsai is so wonderful that many people believe that there must be some mystery about them, some special treatment known only to the initiates so that, as one often hears, "bonsai always die in two or three months in a Western house." But this is not the case. The authors hope that this book will help Western people who own bonsai to care for them and increase their own enjoyment. They also hope it will encourage those who like gardening to experiment in making and training their own miniature trees.

Form

Bonsai are ordinary trees which, whether naturally or artificially dwarfed, have been trained in pots to grow into naturally beautiful shapes. It is important to bear this in mind, for the chief beauty of the bonsai is its form, and even when that form is fantastic it still must not be grotesque. Anyone studying the photographs in this book will understand this. Even the strange "cascade" trees, which grow down over the edge of the pot instead of upwards, should look like trees clinging to a ledge of rock above a



Drastic pruning of mountain maple bonsai. A) before B) after.

Century-old azalea Hinodegiri

precipice. Above all, the bonsai should never be trained into a shape that does not naturally become its species; it should remain a forest tree, seen through the wrong end of a telescope.

Importance of Potting

Bonsai exist only in pots; it is a combination of training and the confining action of the pot that makes the bonsai. The training of a sapling cannot begin until it is put into a pot, and the healthy condition of all dwarf trees depends to a great extent on the way in which the earth in the pots is changed and the roots pruned. A healthy bonsai puts out new roots every year and these roots make it increasingly difficult for water and air to penetrate the soil. The surface roots will get all the nourishment and the main root near the trunk will harden and atrophy. It is therefore periodically necessary to cut back the main root and thin out the surface roots.

How often this is done depends on the tree's rate of growth. Evergreens, such as pines and spruces, require repotting only once in from three to five years; broad-leaved evergreens, such as the camellia and the laurel, and deciduous trees, once every two or three years; flowering trees and fruit trees, every second year, but when the blossom or crop is very heavy it may be necessary to repot after a year; willows and crape myrtle, which are very quick growing, twice a year. It should be remembered that these intervals apply to healthy trees which have received proper care.

The best season for repotting is in the early spring when the first new buds appear. A secondary season occurs in late summer or early autumn when for a short time the roots check their growth before the final autumn shooting.

Care

No one should own a bonsai unless he is prepared to give a certain amount of time every day to its care. As the reader will have gathered, a bonsai is much more like a pet than a plant and needs quite as much attention as a cat or a dog. In fact, there is a great deal in common between the care of a prize poodle and the care of a prize bonsai. Both require daily grooming, regular clipping, constant attention to health, and a good tonic from

Specimen of
Japanese white
pine.

time to time. A bonsai cannot be left to look after itself if the owner goes away; to bury the pot in the garden and hope for the best is no solution. If it must be left for the weekend, it is important to arrange for someone trustworthy to water it regularly at the correct times. It is as well to leave it in a shelter so that a sudden storm will not damage it. If the owner intends to be absent for some time, the best plan is to board the bonsai out with a good nursery which will take an interest in it. If the nurseryman is not accustomed to the care of bonsai, clear instructions should be left with him.

Age and historical association do not necessarily make a good bonsai, and once a tree is mature the Japanese do not require very exact data about its age. What they do require is a healthy plant, an exquisite shape, and a feeling of harmony between tree, form, and setting, for therein, not in its age, lies the value of a bonsai.

Buhle photos

Flowering
crab-apple in
autumn.

THIRTY OUTSTANDING WOODY PLANTS FOR CALIFORNIA

Emily Brown and Elizabeth McClintock

California is the only region in North America to have a Mediterranean climate. This climate found in the coastal and valley areas is characterized by mild winters with moderate rainfall, and warm dry summers. These rather special climatic circumstances make it possible to grow a number of ornamental plants that cannot be grown elsewhere in the United States. Many of these have their native habitats in other geographic regions with a climate similar to that of California. Such regions are Chile and adjacent Argentina in South America, the Mediterranean region of southern Europe and northern Africa, the region around the Cape in South Africa, and parts of Australia and New Zealand.

While some of the hundred "Rembrandts" discussed in the autumn issue of PLANTS & GARDENS can be grown in California, there are a number of outstanding and attractive ornamentals suitable for California which are not widely grown elsewhere. Thirty of these are presented here.

Lilly-pilly
Acmena smithi (Eugenia smithi)

An evergreen, stylish tree, only for coastal California, not tolerant of hot sun or of low temperatures. Its habit is very graceful, the leaf texture excellent. The leaves are pointed, oval, with bronze shadings. The unusual pinkish-lavender berries are large and striking, in showy clusters. Lilly-pilly does best in acid soil and considerable shade. Native to Australia.

Strawberry Tree
Arbutus unedo

An evergreen shrub which may reach 30 feet, about as broad as tall, with full branching habit down to the ground. The leaves are numerous and waxy, close to the branches. Reddish leaf stems add interest. Clusters of cream-colored, closed, bell-shaped flowers are followed by fat fruits, resembling strawberries, mostly red but some yellow, which fall when overripe. The flowering season is erratic and often both flowers and fruit are borne at the same time. A dense shrub, very useful as an informal screen, good in background planting or in large scale shrubbery borders, but also does fairly well in confined areas. It responds to good soil, is disease resistant. Exceedingly drought resistant, but on the other hand is not harmed by water. Requires no pruning and will grow in sun or shade. Native to southern Europe and Ireland.

Netvein Camellia
Camellia reticulata

An excellent garden subject, much less heavy than *Camellia japonica* and with larger flowers than either *C. japonica* or *C. sasanqua*. Its form is open and somewhat angular rather than massed. A number of varietal types imported recently from China are now available. Native to Yunnan Province, China.

Santa Barbara Ceanothus
Ceanothus impressus

Ceanothus hybrids, well known in Europe, are crosses between eastern United States and Mexican species. Some of the best of the western United States species are now being widely distributed in California and are often used as a feature of highway planting. *Ceanothus impressus* is one apt to keep a place among improved forms. It is drought tolerant, but will flourish with garden watering, though under such conditions its life may be cut somewhat as a result of faster development (life span to about twenty years). The flowers do not grow in large loose trusses as in many admired species and varieties but in great numbers of tight, firm, lilac-shaped clusters. In March the whole shrub has a pinkish cast from the unopened buds. In April the rough crinkly leaves are nearly hidden with the deep, almost true blue of the open flowers. From Santa Barbara County, California.

Rock Rose *Cistus hybridus (C. corbariensis)*

An easy shrub, undemanding and permanent, a hybrid between *C. populifolius* and *C. salvifolius.* Numerous branches covered with neat leaves cascade to form an evergreen mound 3 feet or more across. Many wild-rose-shaped flowers blow off in the spring winds after about a month of daily opening. The flowers are small, with white petals and yellow stamens in contrast to *Cistus ladaniferus maculatus,* which has dark magenta blotches on larger white petals. *C. purpureus,* with lavender-pink flowers, has been used in highway planting and for slope covering.

Evergreen Clematis
Clematis armandi

A strong-growing vine of tremendous size, only to be used where there is ample room for its long branches to spread. In late spring numerous clusters of flat white flowers about an inch across appear, very striking at height of blooming season. Not a twining or clinging vine, this clematis must be grown on a fence where upper branches can be trained in a mass along the top, or over a pergola or canopy. After the flowering season, all branches which have flowered, as well as about a third of those which have not, must be cut back severely. Spraying is helpful but not as essential when the growth is kept under control. Needs sun to flower well. Native to China.

Autumn Glory Hawthorn
Crataegus var. Autumn Glory

A medium-sized tree, leafless for only a short period in California. It is a hybrid between *Crataegus pubescens* and *C. oxycantha* and is superior to Carriere's thorn because of its larger, brighter, oval fruits. The birds are not so fond of these handsome shining pomes as they are those of pyracantha and cotoneaster, so they remain on the branches long after ripening, hence the name AUTUMN GLORY. (The leaves do not turn color in fall.) Prune only for cut decoration or to keep well-shaped and open. The tree does not sucker as PAUL'S SCARLET does. In years of bad pear-blight, this hawthorn may be somewhat affected. It has moderate requirements as to soil, is tolerant of dry or wet conditions, and of sun or partial shade.

Grossman photo

Evergreen clematis (*Clematis armandi*).

Formosan Loquat
Eriobotrya deflexa

A small tree or large shrub with handsome evergreen foliage; may be trimmed to a single trunk or left with several. Leaf

Japanese-aralia (*Fatsia japonica*).

texture is similar to Japanese loquat but leaves are somewhat smaller, more toothed, and less hairy. Outstanding for pinkish-bronze color in new leaves. Needs good soil, adequate water, some sun. Not well known but warrants closer acquaintance and broader use. Native to Taiwan.

St. Catherine's Lace
Eriogonum giganteum

A small evergreen shrub with white or gray leaves, with the fuzz typical of one type of drought resistant plant. Natives from dry California hillsides, several members of the Buckwheat family are adaptable to garden use; this one becomes five times larger than usual with food, water, etc., and may even become ungainly. The name *giganteum* probably refers to the flowers, arranged in a flat cluster on a stiffly arching stem, at first cream-colored, later rose, and finally brown. When dried (on the plant or hung in bunches) these make handsome "everlasting" decorations. Requires sun, no care. From Santa Catalina and San Clemente islands.

Organ Mountains Escallonia
Escallonia organensis

An evergreen shrub with numerous, shining, dark green leaves and clusters of small pinkish-white flowers on the tips of each branch and side branch. If spent flowers are pinched off, flowering continues through summer and fall. Good for a "quick show;" in good soil it may spread 5 feet in a year from a gallon can. It needs some staking and training when very vigorous. To keep it from becoming a thirty-foot tree, prune while cutting for decoration. Long lasting. Native to Brazil.

Ribbon Eucalyptus
Eucalyptus viminalis

One of the best of the big eucalypts, this tree will grow to about 100 feet in twenty years. It has drooping, medium-slender foliage; cream-colored flowers; shredding bark. As greedy, thirsty and dirty as all others of the genus but handsome where room allows. Native to Australia.

Australian Brush Cherry
Eugenia myrtifolia
(Eugenia paniculata australis)

A shiny-leaved, narrow shrub or small tree growing to 12 feet or more, excellent for hedges, but tender. Reddish stems lend interest; small cream flowers and berries are noticeable when constant clipping does not reduce the quantity. May be used as a doorway shrub in a tub if given plenty of water and fertilizer. A form called ARMSTRONG, more compact and more pyramidal, is better for containers. Either form is safer in an enclosed porch or at least under a roof overhang. Native to Australia.

Japanese aralia
Fatsia japonica

An easy shrub for partial shade, growing to as much as 20 feet, with large, palmately lobed, glossy, dark green leaves. Long panicles of beige flowers grace the ends of branches, which often arch with their weight. Good in a massed planting under trees in mild regions or as a bold subject for large tubs. Nurserymen sometimes grow two in a can to insure fullness of foliage. Requires a spray program, mostly for aphids. Grows better with water and food, but will tolerate less than many other shade plants require. Native to Japan.

Sweet Shade *Hymenosporum flavum*

A tender, small, evergreen tree with waxy yellow flowers of exquisite fragrance. The crown is naturally wide, the foliage glossy dark green. In a warm climate it would make a charming street tree. Also, it may be trained against a wall. Aside from warmth it needs good soil and moisture. Native to Australia.

California Juniper
Juniperus californica

A graceful small conifer growing to 30 feet, upright and slender, compact but not stiff, the tip often bending rather than erect. The foliage is gray-green and soft, with more "pattern" than, for instance, *Juniperus virginiana*. Native in the higher desert mountain and foothill slopes of California, it adapts easily to sea-level garden conditions. Not often grown for the trade, but should be encouraged. Grown in pairs, this juniper is less pillar-like than Italian cypress (*Cupressus sempervirens*) or Irish yew (*Taxus baccata stricta*) and thus more informal. Requires no wiring or clipping. Native to California.

Broom Tea Tree
Leptospermum scoparium

Various cultivated forms of this plant make useful shrubs for "color" in the garden, especially the crimson ones such as RED DAMASK. Flowers are small, often double, rose-colored, and so closely placed on the stems as almost to hide the heath-like leaves. There is a second flowering season under favorable conditions. The foliage may be bronze, green, or grayish as in var. *Keatleyi*, the wood somewhat stiff and angular. Requires good drainage and no overhead water and looks best against a green background. Cuts well. Native to New Zealand.

Catalina Ironwood
Lyonothamnus floribundus

An evergreen tree of good size (to 50 feet) either with a single trunk or with everal stems from the base. If the tree s destroyed, it will grow from the roots n the latter form unless trimmed to one new shoot. The bark is interesting, dark reddish-brown, peeling off in long strips; the foliage is unusual, with dark green, glossy, fern-like leaves of thick texture. Flat clusters of cream flowers up to 8 inches across are produced on trees fifteen or more years old. Ironwood cannot stand prolonged freezing weather. Most attractive where space allows the planting of a grove. From islands off the coast of Southern California.

Grossman photos

Heavenly-bamboo (*Nandina domestica*).

Heavenly-bamboo
Nandina domestica

Evergreen, but "turns" in autumn especially if grown in sun, becoming brilliant crimson in exposures conducive to coloring. Leaflets narrow, of delicate texture giving feathery effect. Flowers small, white, in panicles at tops of branches, followed by bright red berries. Form erect, to 10 feet, but can be kept much lower. Will sprout from ground if cut far back. Good in groups in open, as loose hedge, or as not-too-flat wall plant. Will tolerate shade and dryish situations. Native to China and Japan.

New Zealand Christmas Tree or Ironwood *Metrosideros tomentosa*

Evergreen, gray-green, much branched tree, with us medium-sized, to 25 or 30 feet. Leaves thickish, fuzzy beneath. Flowers, which appear in fall and winter, are red, forming showy clusters. Recommended for coastal areas and should be planted where it will have room to attain its naturally branching habit. Native to New Zealand.

Mayten Tree *Maytenus boaria*

A small tree with slender, soft, pendulous branches and narrow, delicate, evergreen leaves. It attains a height of 100 feet in Chile but is slow growing in California, usually 20 to 30 feet. It does well as a doorway plant if fed and guarded against aphids. Small greenish-white flowers are inconspicuous. Native to Chile.

Oleander *Nerium oleander*

Shrubby evergreen, needs heat to bloom abundantly. Fine for highway plantings in California's hot valleys. Several varieties have been developed to flower more easily in cooler situations, in several interesting colors, *e.g.*, pale yellow and flesh pink (one of these is named SARAH BERNHARDT). Varieties of more compact form have also been selected; these make excellent tub plants. Oleander must be watched for scale. Tolerates considerable dryness. Native to the Mediterranean region.

Holly-leaved Osmanthus *Osmanthus ilicifolius*

A compact, slow-growing, upright evergreen shrub with waxy, dark green, toothed foliage and regular branching habit. New leaves are bronze; the flowers small, cream-colored, fragrant. Exceedingly disease resistant and more tolerant of cold than the better known sweet olive (*Osmanthus fragrans*). An excellent subject for formal urns or an unclipped hedge. Can be clipped but then has fewer flowers and bronze leaves and less natural form. Will grow to 6 feet but is easily kept to desired size by selective pruning. Will tolerate shade; but grows and flowers better with sun and good soil. Native to Japan.

Coates Crimson India-hawthorn *Raphiolepis indica* var.

A selected form of the India-hawthorn, a native of southeastern China, which has been developed for its more compact habit and for its brighter, larger flowers. Branches tend to spread horizontally; by selective pruning a ground cover 2 feet high may be obtained. Also excellent planted singly in boxes or containers. Foliage is quite bronze, new leaves pinkish, leathery, and neatly alternate. Flowers in loose panicles at tips of branches to about 3 inches long, lasting about half of the year. Fairly pest resistant. Responds to good maintenance, grows in sun or partial shade.

Fragrant Sarcococca *Sarcococca ruscifolia*

A fine broad-leaved, slow-growing, evergreen shrub for shade, producing abundant flowers even in quite dark positions. Flowers small, cream-colored, very fragrant, followed by red berries. Small, shining, dark green leaves are closely arranged on rather soft stems. The shrub may be allowed to sprawl and be kept to 2 feet, or to grow tall and become a loose or clipped hedge. Makes a good container subject; foliage useful as filler in decorations. Native to China.

African-linden *Sparmannia africana*

A big-leaved small tree, to 20 feet, but often almost as wide as tall when many trunked. Extremely fast grower and easily gets out of bounds, but handsome when well grown and given room. Sun comes through the yellow-green, angled, 9-inch leaves, giving pleasant effect. Will grow in shade but needs light and air. Flowers are white and papery with showy yellow stamens. Fine tub plant, even in the house before it becomes too woody. Native to South Africa.

Lily-of-the-valley Tree
Clethra arborea

A fairly large evergreen tree eventually reaching about 20 feet which needs some protection in California. Grows most gracefully in large tubs or in shrubbery borders. Clusters of white bell-shaped flowers, appearing in late summer, suggest the common name. Native to Madeira.

St. Johnswort var. *Rowallane*
Hypericum hookerianum rogersi X H. leschenaulti

A choice St. Johnswort which originated in Ireland. It has bowl-shaped, bright yellow flowers. Shrub about 3 to 4 feet tall and as broad, with good clean foliage, not too "woody" if pruned with care.

Campbell Magnolia
Magnolia campbelli

This deciduous Asiatic magnolia is only for mild climates, without severe cold or heat. May take up to fifteen to twenty years to flower but grafted plants may flower in about ten years. Pink flowers, sometimes as many as three hundred at one time on a single tree, appear in late winter and early spring before the leaves. Silhouetted against the sky they suggest upturned water-lilies. From the Himalayas.

Forrest Pieris *Pieris forresti*

More striking than Japanese pieris because of its longer flower clusters and brighter new leaves, often true, clear pink with occasionally a few deep crimson leaves also. Evergreen with open arching habit. As other ericaceous (Heath Family) plants, it requires acidity. Native to southwestern China.

Rhododendron norbitonense aureum. (R. smithi aureum)

A member of that hybrid group known s Azaleodendrons, this rhododendron is n arching medium-sized shrub with per-istent, rough-textured foliage and clear yellow flowers. It is a hybrid between *R. molle* and *R. maximum* × *ponticum*.

Grossman

Rice paper plant (*Tetrapanax papyriferus*).

Additional Highly Desirable Woody Plants for California

Aucuba japonica
Carpenteria californica
Cytisus species
Dombeya × *cayeuxi*
Drimys winteri
Erica canaliculata var. Boscaweniana
Erythrina caffra and *E. crista-galli*
Fremontia californica
Hoheria populnea
Jacaranda acutifolia
Koelreuteria paniculata
Pittosporum species
Pyrus kawakami
Rhus ovata
Schinus terebinthifolius and *S. molle*
Tetrapanax papyriferum
Tibouchina semidecandra
Vaccinium ovatum

WORTH READING

A SELECTED LIST OF RECENT
NONTECHNICAL BOOKS, MAGAZINE
ARTICLES, AND EXPERIMENT
STATION BULLETINS

General

THE WORLD IS YOUR GARDEN, by W. H. Camp, V. R. Boswell and J. R. Magness. Published by the National Geographic Society, Washington, D. C., 1957. 231 pages. $6.50.

Beautifully illustrated with watercolor plates, this book traces the origins and history of most of our better known fruits, flowers and vegetables.

EXOTIC PLANTS OF THE WORLD, by Marcel Belvianes (translated by Anthony J. Huxley). Published by Hanover House, Garden City, N. Y., 1957. 95 pages. $4.95.

A book for plant-lovers and artists. Beautifully reproduced photographs of plants, both familiar and strange, in color and black and white.

READING THE LANDSCAPE, by May Theilgaard Watts. Published by The Macmillan Co., New York, 1957. 230 pages. $4.75.

A most enlightening book, delightfully written. Enjoyable in itself, it will enable the reader to interpret at least some of the stories written in his everyday surroundings.

MEN AND GARDENS, by Nan Fairbrother. Published by Alfred A. Knopf, New York, 1957. 272 pages. $5.00.

A history of gardening, told in a charming manner by one who knows and loves gardens.

PLANT DOCTORING IS FUN, by Cynthia Westcott. Published by Van Nostrand, Princeton, N. J., 1957. 280 pages. $4.50.

Miss Westcott's own story of her full and exciting career as the "Plant Doctor," told in her inimitable style.

USING WAYSIDE PLANTS, by Nelson Coon. Published by the author, Watertown, Mass., 1957. 256 pages. $3.00.

Interesting ways of using wild plants for food, decoration, dyeing, and other home crafts.

BRITAIN'S WILD LARDER: NUTS, by Claire Loewenfeld. Published by Faber and Faber, Ltd., London, 1957. 312 pages. $4.20.

Ways of using numerous nuts available in the wild in Great Britain, many of which are also obtainable in the United States. Numerous recipes.

BOTANY: AN INTRODUCTION TO PLANT SCIENCE, by Wilfred W. Robbins, T. Elliot Weier and C. Ralph Stock-ng. Published by John Wiley & Sons, Inc., New York, 1957. 578 pages. $6.95.

A well illustrated, readable textbook of botany.

BOTANY FOR GARDENERS, by Harold William Rickett. Published by The Macmillan Co., New York, 1957. 236 pages. $4.50.

Fundamentals of botany presented in a simple, readable manner for gardeners and other amateurs who wish to know more about the plants they work with.

COMMON WILD FLOWERS OF NEW YORK STATE, by Patricia Ellison. New York State College of Agriculture at Cornell University (Ithaca, N. Y.) Extension Bulletin 990, September, 1957. 32 pages.

Descriptions and line drawings enable easy recognition of 50 wild flowers common not only in New York but through much of the northeastern part of the United States.

PLAY WITH SEEDS, by Millicent E. Selsam. Published by William Morrow and Co., New York, 1957. 96 pages. $2.50.

The story of seeds and how they grow told for young gardeners. Simple directions for many interesting experiments with seeds are given.

GARDENING: A NEW WORLD FOR CHILDREN, by Sally Wright. Published by The Macmillan Co., New York, 1957. 183 pages. $2.75.

Numerous suggestions for getting and holding the interest of children in growing plants. Many of the ideas presented have appeal for adults as well.

JOHN MUIR, PROTECTOR OF THE WILDS, by Madge Haines and Leslie Morrill. Published by Abingdon Press, New York, 1957. 128 pages. $1.50.

A biography of the great American naturalist, written for children. Any child will find it exciting reading, and acquire a deeper appreciation of our natural heritage.

A NATURALIST IN PALESTINE, by Victor Howells. Published by Philosophical Library, New York, 1957. 180 pages. $6.00.

Fascinating descriptions of the wild life in a section of the world almost complete-y unknown to most nature lovers.

ALL THE PLANTS OF THE BIBLE, by Winifred Walker. Published by Harper and Bros., New York, 1957. 245 pages. $4.95.

Paintings (printed in black and white) of over one hundred of the plants mentioned in the Bible, with descriptions of each and passages in which they are mentioned.

PLANTS OF THE BIBLE, by A. W. Anderson. Published by Philosophical Library, Inc., New York, 1957. 72 pages. $6.00.

Descriptions of some of the plants more frequently referred to in the Bible, with passages in which they are mentioned. Twelve fine color plates.

U. S. DEPARTMENT OF AGRICULTURE YEARBOOK 1957—SOIL. Published by U. S. Government Printing Office, Washington, D. C., 1957. 784 pages. $2.25.

Very thorough and detailed treatment of soils, their nature and management. Much valuable information for the gardener and farmer.

ATOMIC ENERGY IN AGRICULTURE, by William E. Dick. Published by Philosophical Library, New York, 1957. 150 pages. $6.00.

The effects of radiation on plants, the use of radioactive materials in plant studies and the use of these techniques in agriculture.

TROPICAL RAIN FORESTS, by Delia Goetz. Published by William Morrow and Co., New York, 1957. 64 pages. $2.50.

Beautifully illustrated and simply written story of the rain forests and the plants and animals that make their homes there.

THE LIVING SEA, by John Crompton. Published by Doubleday & Co., Inc., Garden City, New York, 1957. 233 pages. $3.95.

How life in the depths of the sea has evolved into the strange and exciting forms it now exhibits.

THE OPEN SEA—ITS NATURAL HISTORY: THE WORLD OF PLANKTON, by Alister C. Hardy. Published by Houghton Mifflin Co., Boston, 1957. 335 pages. $6.50.

The story of the strange animals and plants that live floating in the ocean. Illustrated with fine photographs and watercolor sketches.

THE JAPANESE ART OF MINIATURE TREES AND LANDSCAPES, by Yuji Yoshimura and G. M. Halford. Published by Charles E. Tuttle Co., Rutland, Vt., 1957. 220 pages. $7.50.

Written by an expert teacher who knows every detail of the art of bonsai, and a graduate of his classes who knows all the problems encountered by the novice, this book is the most complete and thorough yet available on the subject in English. Beautifully bound and printed, with many fine illustrations in black and white an in color.

BONSAI—PHOTOS OF NOW FAMOUS MINIATURE TREES, Vol. 2, edited by Kenji Murata. Published by Kofu-en Nursery, Tokyo, Japan, 1957. 72 plates. About $2.50.

A companion book to the volume published in 1956. Primarily of value as a source-book of ideas for ways of training bonsai.

Gardening Techniques, Landscaping

FUNDAMENTALS OF HORTICULTURE, by J. B. Edmond, A. M. Musser and F. S. Andrews. Published by The Blakiston Co., New York, 1957. 2nd edition. 456 pages. $6.75.

Textbook covering all important phases of horticulture. Designed for a college course, but gardeners who wish to broaden their horticultural background will find it helpful.

TAYLOR'S GARDEN GUIDE, by Norman Taylor. Published by Van Nostrand, Princeton, N. J., 1957. 509 pages. $5.95.

Combines three of the author's earlier books into one, gives simple, basic information on every phase of gardening.

THE COMPOST PILE, by L. H. MacDaniels. New York State College of Agriculture at Cornell University (Ithaca, N. Y.) Extension Bulletin 991, October, 1957. 4 pages.

Clear, easy-to-follow directions for constructing and maintaining a compost heap, with a sober, considered discussion of the use of compost and the claims of organic gardening.

PLANT PROPAGATION IN PICTURES, by Montague Free. Published by the American Garden Guild, Inc. and Doubleday & Co., Inc., Garden City, N. Y., 1957. 249 pages. $4.95.

Complete details of propagating many garden plants, clearly explained with photographs.

PLANT PROPAGATION, by John P. Mahlstede and Ernest S. Haber. Published by John Wiley & Sons, New York, 1957 413 pages. $7.50.

Thorough and authoritative text book on propagating, with special sections on ornamental shrubs, trees, etc.

PROPAGATION OF WOODY PLANTS BY CUTTINGS, by William L. Doran University of Massachusetts (Amherst Mass.) College of Agriculture Experimen Station. Bulletin 491, June, 1957. 99 pages

Excellent information on propagation by cuttings in general, with specific information on the rooting of cuttings of nearly 500 species.

THE MULCHING OF VEGETABLES, by Patricia Rowe-Dutton. Published by the Commonwealth Agricultural Bureaux Farnham Royal, Bucks, England, 1957. 169 pages. $2.80.

Detailed reports on experimental mulching of various vegetable crops, its effects on growth, productivity, pests and diseases.

FLOWERS FROM SEED, by R. E. Lee New York State College of Agriculture at Cornell University (Ithaca, N. Y.) Extension Bulletin 981, June, 1957. 16 pages.

Complete directions for growing annuals, biennials and perennials from seed. Special treatments such as sterilizing and stratifying are included.

BE YOUR OWN NURSERYMAN, by Robert Scharff. Published by M. Barrows and Co., New York, 1957. 233 pages. $3.50.

How to operate a home nursery for raising trees, shrubs and vines for one's own use.

ANNUALS FROM SEED, by Roy Genders. ublished by Dover Publications, Inc., New ork, 1956. 112 pages. 65¢.

Exactly how to grow all kinds of annuals and some biennials) from seed. Gives genral principles and directions for raising pecific kinds.

PLASTIC MULCHES FOR HORTICULTURAL CROPS, by V. A. Clarkson and V. A. Frazier. Oregon State College (Corvallis, Ore.) Agricultural Experiment Staion. Bulletin 562, September, 1957.

Advantages and disadvantages of polythylene as a mulch for vegetable and ther crops. Includes directions for handling the plastic.

LANDSCAPE YOUR HOME, by Don Hoag. North Dakota Agricultural Experiment Station (Fargo, N. D.) Bulletin 407, May, 1957. 16 pages.

Clear, easy-to-understand help for the novice who wishes to landscape his own grounds. Many useful, simple plans and diagrams.

YOUR GARDEN IN TOWN, by Ruth Marie Peters. Published by Henry Holt and Co., New York, 1957. 180 pages. $3.75.

A very useful handbook for city gardeners, telling what can be done in the city and how to do it, whether for small backyard, roof top, window ledge or merely a few flower pots in an apartment.

Trees and Shrubs

TREE CARE, by John M. Haller. Published by The Macmillan Co., New York, 1957. 224 pages. $5.95.

How to plant trees, proper pruning techniques, control of pests and diseases and other pertinent tree information.

HEDGES: THEIR PLANTING AND CARE, by Roy Genders. Published by Dover Publications, Inc., New York, 1956. 4 pages. 65¢.

Everything the home owner should know about growing hedges; where to use them, plants to employ, establishing a hedge, maintenance.

HANDBOOK OF HOLLIES, edited by Harry Dengler. Published by American Horticultural Society, Washington 2, D. C., 1957. 193 pages. $3.00.

A special issue of the National Horticultural Magazine (January, 1957), this is one of the most complete and authoritative volumes on holly available.

CLIMBING PLANTS FOR YOUR GARDEN, by Douglas Bartrum. Published by Dover Publications, Inc., New York, 1956. 79 pages. 65¢.

Useful vines and how to grow them, arranged according to the season when they are at their best.

EVERGREEN AND FLOWERING SHRUBS FOR YOUR HOME, by Katharine M.-P. Cloud. Published by Greenberg, New York, 1957. 248 pages. $4.95.

How to landscape the small property with shrubs. Chapters on culture, propagation, shrubs for various uses; numerous photographs.

THE BOOK OF FLOWERING TREES AND SHRUBS, by Stanley Whitehead. Published by Frederick Warne and Co.. Ltd., London and New York, 1956. 246 pages. $3.50.

A useful guide to shrubs and trees grown for ornamental flowers. Over 250 kinds are described and pictured in color.

AUSTRALIAN TREE PORTRAITS, by Charles P. Mountford. Published by Melbourne University Press and Cambridge Press, New York, 1956. 70 pages. $8.50.

Brief descriptions and superb photographic studies of Australian trees.

CITRUS FRUITS, by Harold H. Hume. Published by The Macmillan Co., New York, 1957. 444 pages. $10.50.

Complete guide for growing citrus fruits, establishing the orchard, handling the fruits for market, etc. Well illustrated.

Garden Flowers

THE LITTLE BULBS—A TALE OF TWO GARDENS, by Elizabeth Lawrence. Published by Criterion Books, New York, 1957. 248 pages. $4.00.

The author tells from her own experience how to grow small bulbs out-of-doors. A wealth of information charmingly presented.

BULB GROWING FOR EVERYONE, by J. F. Ch. Dix. Published by Pitman Publishing Corp., New York, 1957. 147 pages. $3.95.

Descriptions and culture of nearly all the presently available bulb plants. Includes some that are not bulbous in the strict sense, e.g., dahlia.

AN ENCYCLOPAEDIA OF ANNUAL AND BIENNIAL GARDEN PLANTS, by C. O. Booth. Published by The Macmillan Co., New York, 1957. 488 pages. $12.50.

Descriptions of about 1200 species of annuals and biennials, with their culture.

ENCYCLOPEDIA OF ROSES AND ROSE CULTURE, edited by Harcourt P. Champneys and Carl Withner. Published by Prentice-Hall, New York, 1957. 226 pages. $7.50.

Everything a rose grower needs to know on the history, culture, use, and kinds of roses.

THE COMPLETE BOOK OF CHRYSANTHEMUMS, by Cornelius Ackerson. Published by Doubleday and Co., New York, 1957. 256 pages. $4.95.

Culture, pests and diseases, and descriptions of the various kinds of chrysanthemums by a well known grower and fancier. Includes sections on arranging and showing chrysanthemums.

ROSES FOR PLEASURE, by Richard Thomson and Helen Van Pelt Wilson. Published by Van Nostrand, Princeton, N. J., 1957. 207 pages. $5.95.

Old and new roses and how to grow them, by two authors who know their subject from first hand experience.

GERANIUMS, PELARGONIUMS, by Helen Van Pelt Wilson. Third revision. Published by M. Barrows & Co., New York, 1957. 240 pages. $4.50.

Completely revised edition of standard work on geraniums. New material includes chapters on dwarf geraniums, pests and diseases, and revised lists of best kinds.

Pests and Diseases

PLANT PEST HANDBOOK. Connecticut Agricultural Experiment Station (New Haven, Conn.). Bulletin 60. 194 pages.

Useful handbook with introductory sections on pests and their control in general, followed by descriptions and control of pests and diseases of several hundred plants.

PREVENT VEGETABLE DISEASES IN YOUR HOME GARDEN, by O. D. Burke. Pennsylvania State University (University Park, Pa.) Extension Service Circular 471, 6 pages.

Practical suggestions on how to check diseases in the garden before they begin.

INSECT AND DISEASE CONTROL ON VEGETABLES, by J. W. Heuberger, Donald MacCreary and R. F. Stevens. University of Delaware (Newark, Dela.) Agricultural Extension Service. Extension Folder 49, January, 1957.

Brief, concise directions for materials to use and their application to control common pests of vegetables.

HOW TO CONTROL COMMON GARDEN INSECTS, by W. A. Price, J. G. Rodriguez and R. Thurston. University of Kentucky (Lexington, Ky.) Agricultural Extension Service. Circular 548, revised February, 1957. 12 pages.

Twenty common garden insects and how to control them.

IRIS BORER AND ITS CONTROL, by John C. Schread. Connecticut Agricultural Experiment Station (New Haven, Conn.). Circular 202, April, 1957. 7 pages.

Description and life history of iris borer, how to recognize its presence, best methods of control.

CONTROL OF FRUIT INSECTS AND DISEASES IN ORCHARDS AND HOME PLANTINGS, by L. A. Stearns, J. W. Heuberger, and R. F. Stevens. University of Delaware (Newark, Dela.) Agricultural Extension Service. Extension Folder 48, January, 1957.

Spray schedules and materials to use for apples, grapes and peaches.

POISONOUS PLANTS AROUND THE HOME, by Erdman West. University of Florida (Gainesville, Fla.) Agricultural Experiment Station. Circular S-100, August, 1957. 38 pages.

Descriptions of several poisonous plants grown for ornament in subtropical climates and symptoms of poisoning. Useful for Florida residents.

WEED CONTROL, by Collins Veatch. West Virginia University (Morgantown, W. Va.) Agricultural Experiment Station. Circular 101, March, 1957. 15 pages.

How to control weeds with chemicals in farm crops, home vegetable gardens, orchards, flower gardens and lawns. Includes which chemicals to use, when to apply, amounts to use.

CHEMICAL CONTROL OF WEEDS AND BRUSH, by E. C. Spurrier, W. O. Scott and F. W. Slife. University of Illinois (Urbana, Ill.) Extension Service in Agriculture and Home Economics. Circular 771, April, 1957.

Primarily for farmers, but has good tips for home owners on how to use chemical weed killers.

Indoor Gardening and Flower Arrangement

GARDENING INDOORS UNDER LIGHTS, by Frederick H. and Jacqueline L. Kranz. Published by The Viking Press, New York, 1957. 241 pages. $4.95.

Directions and plans for constructing various indoor lighting systems for growing plants with artificial light.

BENEATH THE GREENHOUSE ROOF, by Charles H. Potter. Published by Criterion Books, New York, 1957. 246 pages. $5.95.

Everything the home greenhouse owner needs to know, from putting up the greenhouse to culture of individual plants.

ORCHIDS FOR EVERYBODY, by Lee Wickham. Published by Robert M. McBride Co., New York, 1957. 63 pages. $5.00.

How to grow native orchids from seed, and the story of the author's long search for the key to the secret.

CACTI FOR DECORATION, by Vera Higgins. Published by Pitman Publishing Corp., New York, 1956. 68 pages. $1.95.

Growing cacti as house plants for the beginning cactus enthusiast.

AFRICAN VIOLETS, GLOXINIAS AND THEIR RELATIVES, by Harold E. Moore, Jr. Published by The Macmillan Co., New York, 1957. 323 pages. $10.00.

The culture, pests and diseases, and hybridization of the Gesneriads, with a complete and beautifully illustrated section on the many members of the family and how to recognize them.

FLOWER ARRANGEMENT, by Charles Hewitt. Published by Dover Publications, Inc., New York, 1956. 88 pages. 65¢.

Simple elements of flower arrangement for the beginner.

A TREASURY OF CHRISTMAS DECORATIONS, by Zelda Wyatt Schulke. Published by Hearthside Press, New York, 1957. 128 pages. $3.95.

Ideas and suggestions for making a great many Christmas decorations, ranging from simple to elaborate.

DECORATING WITH PODS AND CONES, by Eleanor Van Rensselaer. Published by Van Nostrand, Princeton, N. J., 1957. 179 pages. $4.95.

Gives many attractive and amusing ways to use pods and cones, with suggestions as to what material is best, and where it may be obtained.

ABC OF DRIFTWOOD FOR FLOWER ARRANGERS, by Florence M. Schaffer. Published by Hearthside Press, New York, 1957. 128 pages. $3.95.

Where to look for driftwood, how to treat it for use, and a wealth of excellent photographs suggesting how to use it in flower arrangements.

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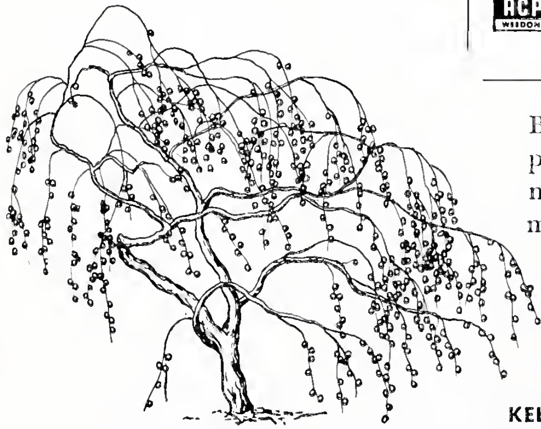

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